DOCUMENT RESUME

ED 259 471 EA 017 937

AUTHOR	Harroun, Jack T., Ed.
TITLE	The NEW Good School Maintenance. A Manual of Programs and Procedures for Buildings, Grounds, and Equipment. Second Edition: Revised and Expanded.
INSTITUTION	Illinois Association of School Boards, Springfield.
PUB DATE	84
NOTE	248p.
AVAILABLE FROM	Publication Sales, Illinois Association of School Boards, 1209 South Fifth Street, Springfield, IL 62703 ($25.00; quantity discounts).
PUB TYPE	Guides - Non-Classroom Use (055)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Cleaning; *Custodian Training; *Equipment Maintenance; Repair; Sanitation; School Buildings; *School Maintenance

ABSTRACT

This manual is designed to fill two distinct needs in the school maintenance field: (1) a text or resource in training new maintenance staff members and in staff development, and (2) a reference source for the routine tasks and problems encountered in school sanitation and maintenance. Section 1 covers the basics of good school maintenance, including management, use of computers, controlling energy costs, safe maintenance practices, and designing buildings for efficient maintenance. Section 2 focuses on cleaning and general building services. Topics include organizing the custodial operation, creating a local handbook for custodians, area cleaning programs, custodial procedures and services, equipment and supplies, a custodian's glossary, and maintenance of synthetic surfaces. Section 3 covers maintaining the building, both exterior and roof, while section 4 covers maintaining school grounds. Section 5 focuses on maintaining mechanical equipment: heating and air conditioning systems, sanitary systems and fixtures, sewage treatment plants, electrical systems, and food service equipment. Section 6 is a management tools appendix, consisting of forms and checklists for effective maintenance management in the areas of cleanup and general building services, grounds maintenance, mechanical equipment, and annual inspection. (TE)

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THE NEW GOOD SCHOOL MAINTENANCE

A manual of programs and procedures for buildings, grounds, and equipment

Second Edition
REVISED and EXPANDED

EA 017 937

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Good School Maintenance Manual Committee
of the
Illinois Association of School Boards
Service Associates

The following individuals served on the committee which planned and developed this Manual over a period of nearly three years, 1974 to 1976:

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The NEW Good School Maintenance

A manual of programs and procedures for buildings • grounds • equipment

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The Illinois Association of School Boards, the firms of various authors and editors, and the authors and editors themselves disclaim any liability or responsibility for the use or misuse of information contained in *The NEW Good School Maintenance*. Any question concerning a particular subject should be referred to the appropriate IASB Service Associate firm or other qualified source.

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A word about The NEW Good School Maintenance

A major aim of the IASB Service Associates is to call attention to the need for sensible maintenance planning. A second aim is to provide any help that school officials may need in implementing maintenance programs. These two purposes led to the development of *The NEW Good School Maintenance*.

The manual itself is designed to fill two distinct needs in the school maintenance field:

1) The manual is intended as a basic training tool. It can be used as a text or resource in training new maintenance staff members. Members of the maintenance staff can use it to refresh their knowledge—in effect, to train themselves. The manual is probably best viewed as one tool in a larger, continuing program of staff development.

2) The manual also is intended as a reference source. It covers most routine tasks and problems encountered in school sanitation and maintenance. The maintenance staff member who is stumped for an answer may well find it in this manual.

As a training tool, this manual should prove useful to the maintenance manager as well as to the staff trainee. As a reference source, both should find it equally helpful.

A Third-Generation Manual

The beginning of *Good School Maintenance* dates back to 1964 when IASB Service Associates published the first section to the *Planned Maintenance Manual*. Over the years, that manual—published in a ring binder—grew in size and complexity. It was finally decided in 1973 to begin from scratch—to totally re-evaluate, re-plan and re-publish the manual in book form.

The first edition of *Good School Maintenance* appeared in 1976 with material updated and expanded from the original ring binder. The book included a new section on sanitation by Jack T. Harroun, of the University of Illinois, who still serves as Senior Editor. The success of *Good School Maintenance* exceeded expectations, as more than 6,000 copies were sold by the end of 1982. By that time, plans already were in motion to expand and up-date the book.

The NEW Good School Maintenance represents a third generation of the maintenance manual. At the suggestion of many users, the section on Cleaning and General Building Services has been expanded from two chapters to seven and now provides a comprehensive guide to custodial operations. In Chapter Eight, the school is divided into 13 areas that need cleaning, and each area cleaning program (such as for classrooms) cites detailed procedures for specific tasks (such as dusting or sweeping) that are found in Chapter Nine.

The NEW Good School Maintenance contains a good deal more that is new, including chapters on computers and on synthetic tracks, that were not in the 1976 manual. Many of the same authors and some of their original material appear in the new edition, of course, but all of it has been carefully reviewed and up-dated.

Role of Service Associates

The NEW Good School Maintenance is made possible by the Service Associates of the Illinois Association of School Boards. Service Associates consist of firms that do business with schools and are invited to become members based upon their reputations for honesty and integrity. The member firms each appoint an individual to work with IASB in governing the Service Associates and carrying out its programs. (Service Associate programs range from workshops and publications to the practical interpretation of standards and proposed standards.)

Service Associate firms donated untold hours to the development of this manual. Those who contributed material are listed on pages vi and vii. Those individuals who served on the Maintenance Manual committee over the past three years of redevelopment are listed at the front of this book. A complete list of Service Associate members appears in each issue of *Illinois School Board Journal*.

We sincerely hope that this manual will prove helpful both in stimulating interest in effective maintenance planning and in actually carrying out such plans. We remain eager to obtain suggestions and criticisms of this manual to aid in making future improvements.

Harold P. Seamon
Executive Director
Illinois Association of School Boards

Contributors

Numerous technical experts, writers, editors and reviewers have contributed to the contents of *The New Good School Maintenance*, both in its original form and in this new revised edition.

Overall responsibility for the manual rests with the IASB Service Associates Maintenance Manual Committee, the Senior Editor Jack T. Harroun, and the IASB Communications Department, which handled final editing and production.

IASB also acknowledges the able assistance of the staff of the Texas Association of School Boards in reviewing and editing *The NEW Good School Maintenance*. The TASB staff became involved in the project in adapting the text—particularly the section on lawns—for a special Texas edition. They made many valuable suggestions for improving the entire book, as did their consultant, Ben Graves, executive director of the Educational Facilities Laboratory, in Austin, Texas.

Of particular importance are those individuals who drafted sections, chapters, or other items for the manual. They provided the expertise. Some of them wrote material for the original manual; some wrote new material or revised original text for this revised and expanded edition.

The IASB Service Associates acknowledge the following individuals for their contributions:

1) Managing a School Maintenance Program—a new text compiled by the IASB staff from materials supplied by **Jack T. Harroun,** University of Illinois, and **John T. Courson,** president of MOP Corporation, who contributed the chapter in the original edition.

2) Using Computers in School Maintenance—a new chapter supplied by **Jack T. Harroun,** University of Illinois.

3) Controlling Energy Costs—a new text supplied by **Ronald W. Mixer,** of Beling Consultants, Inc.

4) Safe Maintenance Practices—original chapter supplied by the 1976 Maintenance Manual Committee; reviewed and updated by **Keith Middleton,** of Middleton and Associates.

5) Designing Buildings for Efficient Maintenance—original chapter by **Jack T. Harroun,** University of Illinois; reviewed and updated by **Keith Middleton,** of Middleton and Associates.

6) Organizing the Custodial Operation—a new chapter supplied by **Jack T. Harroun,** University of Illinois.

7) Creating a Local Handbook for Custodians—a new chapter supplied by **Jack T. Harroun,** University of Illinois.

8) Area Cleaning Programs, a new chapter supplied by **Jack T. Harroun,** University of Illinois.

9) Custodial Procedures and Services—a revised and expanded chapter by **Jack T. Harroun,** University of Illinois.

10) Equipment and Supplies—a revised and expanded chapter by **Jack T. Harroun,** University of Illinois.

11) A Custodian's Glossary—reprinted with permission from the *Glossary of Environmental Sanitation*, copyright 1968 by the Environmental Management Association.

12) Maintaining Synthetic Counter Tops and Table Tops—a new chapter by **Keith Middleton,** of Middleton and Associates.

13) Exterior Building Care—original chapter by **Alan Anderson,** of Phillips, Swager and Asso-

ciates; reviewed and updated by **Keith Middleton,** of Middleton and Associates.

14) Roofing Care—original section on built-up roofing by **Alan Anderson,** of Phillips, Swager and Associates; revised and expanded by **Richard L. Doyle,** of Richard L. Doyle and Associates. New section on single-ply roofs provided by **Keith Middleton,** of Middleton and Associates.

15) Effective Grounds Management—a revised and updated chapter by **David Bowman,** superintendent of Allerton Park, University of Illinois.

16) Tree and Shrub Care—a revised and updated chapter by **David Bowman,** University of Illinois.

17) Building a Lawn—a revised and updated chapter by **David Bowman,** University of Illinois.

18) Caring for Bituminous Paving—a new text supplied by **Keith Middleton,** of Middleton and Associates.

19) Maintaining Soft-Surface Running Tracks—a new chapter supplied by **Keith Middleton,** of Middleton and Associates.

20) Heating and Air Conditioning Systems—this chapter consists of 11 separate pieces, as follows:

- Boilers—original chapter by **G. L. Kasparian,** of Kewanee Boiler Corporation; reviewed by the author and **Geoffrey M. Hailey,** of Kewanee Boiler Corporation.
- Gas and Oil Burners—original article by **John Klinger,** of Peabody, Gordon-Piatt, Inc.; reviewed by **Marvin Biggs,** of Peabody, Gordon-Piatt, Inc.
- Water Treatment—original article by **James W. Humphreys,** of Beling Consultants; reviewed by Lawrence W. Groves Consultants.
- Pumps—original article by **Joseph J. Blackmore,** of Blackmore and Glunt, Inc.; reviewed by **Craig Powell,** of John A. Sandberg Company.
- Steam Traps—original article by **J.A. Kremers,** of Armstrong Machine Works; revised and updated by **Ray Bragg** and **William Halpin,** of Sarco Company, Inc.
- Valves—original article revised and updated by the author, **Charles K. Henriksen,** of Phillips, Swager and Associates.
- Unit Heaters and Unit Ventilators—original articles by **Myron E. Hunzeker,** of Trane Company; revised and updated by **John Flowers,** of American Air Filter Company.
- Air Handling Units—original article reviewed by the author, **Myron E. Hunzeker,** of Trane Company.
- Rooftop Air Conditioning—original article by **G. P. Rucker,** of Trane Company; reviewed by **D. F. Moran** and **Robert Muirhead,** of Monmouth Company.
- Temperature Control Systems—a new text supplied by **Jim Enlow,** Barber-Colman Company.

21) Sanitary Systems and Fixtures—original article by **F.L. Downs,** of Brown, Davis, Mullins and Associates; revised and updated by **Richard R. Miller,** of Beling Consultants.

22) Sewage Treatment Plants—original article by **Walter G. Kimmell,** of Kimmel-Jensen-Wegerer-Wray, with materials from Brown, Davis, Mullins and Associates and the Ohio Trade and Industrial Education Service, expanded and updated by **Henry Mayer** and **James Merchie,** of Beling Consultants.

23) Electrical Systems—original text by **Charles R. Kuglin,** of Childs and Smith, Inc.; **Lowell N. Peterson,** of Beling Consultants, and **R. W. Bardach,** of Peabody, Gordon-Piatt, Inc.; expanded and updated by **J. E. Ramshaw,** of Brown, Davis, Mullins and Associates, Inc.

24) Food Service Equipment—original chapter by **Ben Boyd,** chief sanitarian, McLean County Health Department, revewed by **Keith Middleton,** Middleton and Associates.

Management Tools Appendix consists of ready-to-use forms supplied by the various contributors listed above.

Annual Inspection Check Lists—original check lists developed by **Gene Swager** and **Charles Henriksen,** of Phillips, Swager and Associates, **Ward Jensen,** of Kimmel-Jensen-Wegerer-Wray, and **Roy Conrad,** of Beling Consultants; reviewed and updated by **Chuck Blve,** of Phillips, Swager and Associates.

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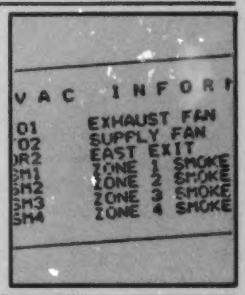
Section One
BASICS OF GOOD SCHOOL MAINTENANCE



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1/Managing a School Maintenance Program

Management means getting things done through other people. It requires coordination of manpower, machinery and materials with specific purposes in mind.

Because school budgets are seldom adequate to finance ideal programs, the maintenance manager must set goals and plan carefully to obtain best results from available resources. Among other things, this means determining standards of cleanliness and upkeep that are acceptable—yet ones that can be achieved with the resources available.

To do this effectively requires the involvement of the entire school community—students, staff, administration and school board—but it is the maintenance manager who is responsible for developing budgets and programs and seeing that they are carried out.

Some basic elements of an effective management program are as follows:

Policy and Division of Responsibility

The school board should develop a written, general policy outlining the overall goals of the maintenance program. The board should seek input from maintenance managers to make sure the goals are realistic.

The school administration, in cooperation with the maintenance manager, should develop written regulations outlining the responsibilities of all members of the school community in regard to the care and upkeep of buildings, grounds and equipment.

Planning

Effective planning must be based on carefully thought-out objectives and priorities. The manager must determine, in keeping with the school board's goals, what services are most important and how often they need to be performed. Three kinds of plans are needed:

Current plans include the daily and periodic scheduling of routine maintenance activities. They detail services to be accomplished, instructions on how these will be done, and controls to provide measurement of results.

Short-range plans generally cover a period of one or two years, and may include such items as major repairs or replacement of large equipment. Careful projection of large-ticket items is necessary so they may be included in budgets and time schedules.

Long-range plans will include large-scale construction or landscaping projects. They are formulated in conjunction with school administration and/or the school board, and frequently require outside technical assistance.

Organization

The purpose of organization is to obtain the maximum benefits with the least effort and cost. Dollars budgeted for manpower, equipment and supplies normally will not be adequate to perform all tasks that are needed. Thus, the maintenance manager is constantly challenged to find more efficient ways of doing things.

The critical elements required to properly organize maintenance operations are:

Organization of work: Priorities must be established so the critical tasks receive attention first. Normally, these will be the services that are necessary to safeguard the health and safety of those using the facilities. The proper sequence of activities necessary to complete the tasks efficiently should be established.

Organization of people: Tools include an organization chart and job descriptions for all employees. These should show daily worker-hours available, broken down into the various skill classifications.

Organization of equipment and supplies: When materials needed to do a job are not available, time is wasted. The maintenance supervisor must plan for secure storage, proper use, and regular replacement of equipment and supplies.

A number of tools are helpful for organizing, including schedules of daily and periodic work, written work assignments, work reports, personnel evaluations and inspection reports. See the Management Tools Appendix in Section Six for tools that may be reproduced or adapted for local use.

Match-up and Assigning Work

The maintenance manager must constantly evaluate the maintenance workload in terms of time and skills required to complete the necessary tasks. The manager then allocates man-hours, materials, and skills to complete the assignments. This process is known as "match-up."

Before work is assigned, the maintenance manager should prepare batches of work, work orders, or individual work tasks. Each task should require a known amount of time for completion. When assigned a measured amount of work, the maintenance staff member should be informed of the expected rate of production and time of completion. Work assignments normally should be written.

Training and Evaluation

A regular program of training for maintenance staff should be established by policy. In addition to initial training for new workers, special training will be needed in the use of new products, equipment, and techniques. Continuing training scheduled on a regular basis is desirable to refresh and update skills.

To enhance on-the-job learning, as well as to monitor work being accomplished, two types of evaluations are needed: periodic evaluation of specific jobs and regular personnel evaluations. The latter are usually done annually, and the perpose should be to promote productivity and to identify any problems. See the Management Tools Appendix for sample forms.

Professionalism

The majority of maintenance employees want to do a good job, and when treated as professionals, will respond by displaying a professional attitude. This includes knowledge of the job, dependability, and a positive attitude toward the work and the organization.

It is the manager's responsibility to ensure that employees have the opportunity to function efficiently, through proper organization, coordination of work, and follow-up. Professionalism can be fostered by involving the entire maintenance team in setting work objectives and planning schedules.

Managers may wish to investigate the "quality circles" management concept, widely used in Japan and becoming popular in the United States as well. The quality circle consists of a small group of workers that meets regularly to identify, analyze and solve problems. Workers are encouraged to take the initiative instead of waiting for instructions. The system has been found to motivate employees to higher levels of productivity by building a sense of mutual purpose and respect among managers and workers. Although the system must be carefully planned and directed to avoid aimless, nonproductive sessions, some managers may find it effective.

In any case, all members of the maintenance crew should be expected to take responsibility for effective, efficient use of time and materials.

Management Responsibilities

The maintenance program manager has two overall areas of responsibility: to enable the maintenance team to function at maximum efficiency and to ensure that the goals and objectives of the maintenance program are being met with available resources.

To permit most effective functioning of employees, the manager must provide them with:

- An achievable goal
- A basis for gaining recognition
- A basis for measuring their own performance and progress
- A basis for developing pride and self-esteem by knowing they have done a job within the guidelines set by management.

To ensure that satisfactory progress is being made toward goals and objectives and that tasks are completed at reasonable cost, the manager must keep records that reflect departmental performance and progress. This follow-up must lead to the improved performance of individual employees as well as to improved planning and organizing.

This manual is intended to increase the efficiency of the maintenance team. Material in subsequent chapters emphasizes the importance of planning maintenance tasks and organizing and executing them in an efficient sequence. Particular attention is given to the planning and organizing of:

- Personnel
- Assignment of tasks
- Standards
- Time
- Procedures
- Equipment
- Costs

In summary, a well-managed maintenance program is based upon:

1) Carefully-defined, realistic goals and objectives.

2) Current, short-range and long-range plans for carrying out the objectives within resources available.

3) Organization of personnel and equipment for most efficent performance.

4) Regular training and evaluation of personnel and the fostering of a professional attitude among the maintenance team.

5) Monitoring and follow-up to ensure that progress is being made toward objectives.

2/Using Computers in School Maintenance

Computers are catching on in schools because they can help students learn and help administrators with a wide array of management tasks.

As school administrators learn more about the computer, they will use it to control physical plant operations and maintenance. In the long run, the computer's greatest contribution to efficient school management may prove to be its application to physical plant activities. These activities are diverse, involving everything from grounds maintenance to boiler maintenance to heating and air conditioning controls. Though diverse, these activities are frequently the responsibility of a single manager—and their management can be handled more efficiently with a computer.

Various industries with physical plant operations similar to those of schools are already using computers to manage their physical plant operations and maintenance. School maintenance supervisors need to be aware of what computers can do to help them. They also should prepare themselves to capitalize on the opportunities when computers become available to them.

The management functions that a computer can improve for the maintenance supervisor include:

- scheduling the operation of the heating and cooling system;
- monitoring such critical factors as weather conditions, heating/cooling system functions, security, and fire safety measures;
- reporting on the condition of equipment, energy usage, and manpower usage.

COMPUTER SCHEDULING

Scheduling the start-up and shut-down of heating/cooling systems is always a challenge. The aim is to avoid uncomfortable students and teachers on the one hand and unnecessary energy consumption on the other. Holidays and unscheduled meetings add to the difficulty of balancing cost with comfort.

The solution is to connect the appropriate equipment to a computer that is programmed to manage scheduling problems. By feeding proper instructions to the computer, the supervisor keeps building occupants comfortable without running costly equipment all night or on weekends.

COMPUTER MONITORING

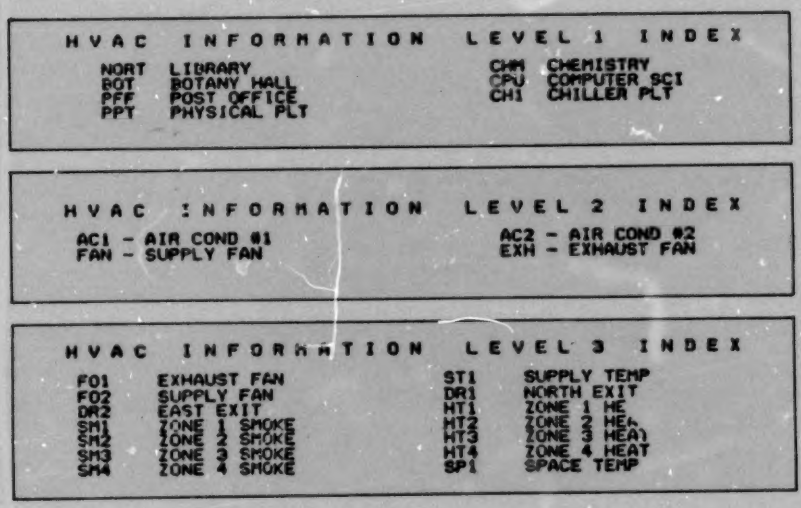
Has it ever happened that school had to be cancelled because a coil froze and there was water everywhere? Wouldn't it have been nice to have known this when the coil froze at 10:00 p.m. instead of at 5:00 a.m. when the custodian found the water?

A computer never sleeps and can monitor the status of critical equipment 24 hours a day, seven days a week. The computer can be programmed to take appropriate action when equipment failure is detected. For example:

Monitoring weather conditions—The computer can be set up to monitor the outside temperature and the presence of moisture to alert the staff to the need for snow removal. The computer can even be programmed to automatically call the supervisor at home if the situation occurs after working hours.

Monitoring heating/cooling systems—A computer can be programmed to react to just about any type of equipment condition. If an air conditioning coil begins to freeze, the computer can quickly alert the proper maintenance people. The computer will not prevent the problem, but it can detect it early and prevent equipment failure. The computer can be programmed to monitor the heating/cooling system and to give notification if equipment fails to start-up or shut-down.

Monitoring security—After-hours monitor-



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HVAC  INFORMATION  LEVEL 1  INDEX

  NORT  LIBRARY                 CHM  CHEMISTRY
  BOT   BOTANY HALL             CPU  COMPUTER SCI
  PFF   POST OFFICE             CHI  CHILLER PLT
  PPT   PHYSICAL PLT

HVAC  INFORMATION  LEVEL 2  INDEX

  AC1 - AIR COND #1             AC2 - AIR COND #2
  FAN - SUPPLY FAN              EXH - EXHAUST FAN

HVAC  INFORMATION  LEVEL 3  INDEX

  FO1   EXHAUST FAN             ST1   SUPPLY TEMP
  FO2   SUPPLY FAN              DR1   NORTH EXIT
  DR2   EAST EXIT               HT1   ZONE 1 HE
  SM1   ZONE 1 SMOKE            HT2   ZONE 2 HEA
  SM2   ZONE 2 SMOKE            HT3   ZONE 3 HEAT
  SM3   ZONE 3 SMOKE            HT4   ZONE 4 HEAT
  SM4   ZONE 4 SMOKE            SP1   SPACE TEMP
```

Figure 2-1—Information level index categorizing equipment by location (level 1 at top), type (level 2 at center) and function (level 3 at bottom).

ing of security zones may be accomplished through the school computer. Connecting the computer to critical security points allows it to review the security status of critical zones within the school anytime of the day or night. The computer also can be programmed to take preventive action, once the critical security points are connected, such as automatically calling the police station or a staff member who knows what to do. The computer also can be set up to seal off doors and exits.

Monitoring fire safety—Fire safety is of critical concern in school buildings. The computer system can be set up to monitor critical areas within the school and, if a fire is discovered, to take the proper action. Actions that can be triggered by a computer include:

- announce alarms
- control dampers
- announce evacuation
- control elevators
- activate sprinklers
- report conditions to a central location, including a fire station.

All of these functions are critical to the proper management of a fire.

COMPUTER REPORTING

A computer, of course, can store, manipulate, and report on masses of information. These capabilities enable the computer to function as a tool for reporting on the performance of the school's physical plant. Three kinds of physical plant information need to be stored, manipulated and reported: equipment, energy, and manpower.

Equipment reports—The computer will centralize all information about the heating/cooling equipment that is connected to the computer. The computer can then produce orderly reports on the current status of the equipment. Figure 2-1 shows how the different equipment within a school may be categorized logically by location, type, and function. Once equipment is organized in this manner, the school's physical attributes can be efficiently evaluated with the instantaneous equipment status report shown in Figure 2-2.

```
HVAC -     FIELD DATA POINTS   PGM DAY   2  MON  05 OCT 1981    09:30    PAGE #  1

FOR:CENT CENT PLANT      CH2  CHILLER 2
  CS   CHILLER           ON                CHS  CHW SUP TEMP     42.0  F
  P3   CHW PUMP          ON                CHR  CHW RET TEMP     51.7  F
  P4   CW PUMP           ON                FLO  CHW FLOW        876.5  GPM

                              05 OCT 1981   09:30
```

Figure 2-2—Instantaneous equipment status report shows equipment type, location, function, and current status.

TIME INTERVAL: 5

COL	SYS	LEVEL I	LEVEL II	LEVEL III	ENG
01	F	LIBR LIBRARY	SMK SMOKE DETECT	DS1 DUCT SMOKE	
03	H	CENT CENT PLANT	ELE ELECTRICAL	DMI DEMAND MTR 1	KW
05	H	CENT CENT PLANT	CH1 CHILLER 1	CHR CHW RET TEMP	F
07	H	CENT CENT PLANT	CH1 CHILLER 1	CHR CW RET TEMP	F
09	H	GYM GYMNASIUM	AH1 AHU 1	DAT DISCH TEMP	F
11	H	GYM GYMNASIUM	AH1 AHU 1	RAH RET AIR HUMD	% RH

COL	SYS	LEVEL I	LEVEL II	LEVEL III	ENG
02	S	LIBR LIBRARY	RED MEDICAL WING	ED EAST DOOR	
04	H	CENT CENT PLANT	CH1 CHILLER 1	CHS CHW SUP TEMP	F
06	H	CENT CENT PLANT	CH1 CHILLER 1	CHS CW SUP TEMP	F
08	H	GYM GYMNASIUM	AH1 AHU 1	SF SUPPLY FAN	
10	H	GYM GYMNASIUM	AH1 AHU 1	MAT MIX AIR TEMP	F
12	H	GYM GYMNASIUM	AH1 AHU 1	RAT RET AIR TEMP	F

TL	TIME	1	2	3 KW	4 F	5 F	6 F	7 F	8	9 F	10 F	11 % RH	12 F
2	12:01	NOR	NOR	8457.8	42.2	49.8	81.6	89.5	ON	65.5	56.9	51.7	66.9
2	12:06	NOR	NOR	8578.7	42.3	49.8	82.0	90.0	ON	65.5	55.3	53.3	67.7
2	12:11	NOR	NOR	8110.2	42.5	50.5	82.3	89.4	ON	65.5	55.3	52.8	67.7
2	12:16	NOR	NOR	7678.3	42.7	50.8	82.3	89.4	ON	65.1	56.2	55.1	67.2
2	12:21	NOR	NOR	8087.3	42.4	50.7	81.9	88.9	ON	65.7	56.2	55.1	68.3
2	12:26	NOR	NOR	8372.5	42.1	51.0	81.2	88.9	ON	64.9	57.3	52.3	68.3
2	12:31	NOR	NOR	8585.8	42.1	50.6	81.2	88.9	ON	64.0	56.1	51.1	68.3
2	12:36	NOR	NOR	8172.7	42.5	50.6	81.7	89.1	ON	64.0	58.0	51.1	68.3
2	12:41	NOR	NOR	8600.1	42.8	50.5	81.3	90.3	ON	65.3	57.1	50.7	68.3
2	12:46	NOR	NOR	8543.3	42.8	50.1	81.3	90.3	ON	66.5	57.1	49.2	67.3
2	12:51	NOR	NOR	8015.6	43.2	50.3	81.3	88.7	ON	66.0	56.3	50.1	68.7
2	12:56	NOR	NOR	8347.5	42.9	50.3	81.2	88.3	ON	65.7	55.2	50.9	68.1
2	13:01	NOR	NOR	8125.6	42.6	50.5	80.8	88.3	ON	66.0	55.9	52.3	67.8
2	13:06	NOR	NOR	7720.1	42.5	50.7	81.5	89.0	ON	64.5	55.9	51.4	68.4
2	13:11	NOR	NOR	7890.1	42.7	50.7	81.9	89.5	ON	64.5	57.1	52.0	67.1
2	13:16	NOR	NOR	8364.5	42.3	51.1	81.5	89.9	ON	66.1	57.9	51.7	66.9
2	13:21	NOR	NOR	8364.5	42.6	50.5	81.1	89.9	ON	65.4	56.7	51.1	67.7
2	13:26	NOR	NOR	8653.9	42.5	50.2	81.4	88.6	ON	64.8	56.7	50.3	67.7
2	13:31	NOR	NOR	9598.3	42.5	49.8	81.8	88.3	ON	64.8	55.9	50.9	68.0

Figure 2-3—Trend log with equipment status recorded at five-minute intervals.

In schools, problems often arise either after hours or when no one is around to observe. The school computer can log information at regular intervals and make it available for later evaluation. This type of reporting is termed "trend logging" and is illustrated in Figure 2-3. The trend log may be set up to print the current conditions of equipment every one, five, or ten minutes so a problem may be evaluated with the proper equipment information.

When set up to coordinate occupancy and equipment schedules, the computer must provide the supervisor with scheduling reports. Figure 2-4 shows a weekly schedule for equipment operation, which can be compared with scheduled school activities for verification.

The school computer can be programmed to provide runtime information on the equipment con-

S	KEY 1	KEY 2	KEY 3	LEV 1	LEV 2	LEV 3	PARAMETERS	TIME	DAYS
H	STA			ADM	AH1	FAN		800	.23456..
H	STO			30	3	1		1700	12345678
H	STO			30	4	1		1700	12345678
H	STO			30	7	1		1700	12345678
H	STO			30	8	1		1700	12345678
H	STO			30	20	1		1700	12345678
H	STO			30	23	1		1700	12345678

Figure 2-4—Summary of scheduled equipment operation can be verified by comparing with scheduled school activities.

```
                    TOTALIZATION SUMMARY

TOTAL     L1      L2      L3      SAMPLED VALUE          STATUS:  BEGIN
          LIBR    CHI     STR         CLO           BASE UNITS:  HRS
                                                    TOTALIZE ON:  CLOSED

   TOTALIZED VALUES                          TOTALIZED LIMITS

   TODAY:      5.05 HRS
   CURRENT:  300.00 HRS                      WARNING:  400.00 HRS
   LAST MAX: 500.00 HRS  AT 12 MARCH 79  15:30  RESET:  500.00 HRS
```

Figure 2-5—Runtime totals are invaluable in planning preventive maintenance.

```
                ENERGY MANAGER PERFORMANCE SUMMARY

FOR:  MED  MEDICAL WING     POW  POWER SYSTEM          STATUS:  BEGIN

      FEATURE                                  SAVINGS
      LOAD MANAGER                  ENERGY     DEMAND     COST
        DEMAND LIMITING             ------      _2500     _2750
        DUTY CYCLE                   _2200                 _950
                          SUBTOTAL   _2200      _2500     _3700
      HVAC MANAGER
        OPTIMAL RUN TIME             __875      ------     __370
        SUPPLY AIR RESET             __220      ------     ___85
        ENTHALPY SWITCHOVER          __175                 ___70
                          SUBTOTAL   _1270      ------     __525
                       GRAND TOTAL   _3470      _2500     _4225
```

Figure 2-6—Energy usage broken down into electrical loads and heating/ventilating/air conditioning groups.

nected to the computer. Such information, illustrated in Figure 2-5, is invaluable in planning preventive maintenance.

The summary of runtime allows maintenance staff to evaluate the level of maintenance required for each piece of equipment connected to the computer. The computer also can announce when a piece of equipment runs past its maintenance interval and requires immediate attention.

Energy reports—The common method for evaluating school energy usage is to examine utility bills. However, most bills do not show *where* energy is going. The computer can monitor and report energy usage by location and even by each piece of equipment. It also can detect and take or suggest corrective measures.

The performance of the energy systems within the school may be reported in the manner shown in Figure 2-6. Logically breaking down the energy systems into electrical loads and heating/ventil-

```
                        D A I L Y   P R O F I L E

DATE       PROFILE   TOTAL ENERGY, KWH          PEAK DEMAND, KW
           TIME      UNCNTRLED   MEASURED   UNCONTROLLED          MEASURED
05/05/82   ALL         35356       34321    3123 AT 12:10  L    2701 AT 13:12

                        P E R I O D   P R O F I L E

START      PROFILE   TOTAL ENERGY, KWH          PEAK DEMAND, KW
DATE       TIME      UNCNTRLED   MEASURED   UNCNTRLED     MEASURED   BILLED  RATCHET CLAUSE
05/01/82   ALL       3245121     2931621    3512  L       3223         0        100
04/01/82   ALL       2718237     2461218    3409  L       3002       3217        25
03/01/82   ALL       2612757     2409797    3346          2972       3145        10
```

Figure 2-7—Electrical load summary is helpful in avoiding new electrical demand peaks.

```
FOR : LIBR - LIBRARY          FN1 - FAN SYSTEM
                                SAVINGS TODAY
     OPTIMAL START TIME        223.5 KWH  OPTIMAL STOP TIME      0.0 KWH
     SUPPLY AIR RESET         1430.0 BTU  ENTHALPY SWITCHOVER     0.0 BTU
                                PERIOD SAVINGS
     OPTIMAL START TIME      10280.0 KWH  OPTIMAL STOP TIME   2831.0 KWH
     SUPPLY AIR RESET           37.6 KBTU ENTHALPY SWITCHOVER     0.0 KBTU
     PERIOD START : 06 FEB  82
```

Figure 2-8—Performance summary reports the energy savings from various measures applied to one fan system.

ating/air-conditioning groups allows the supervisor to evaluate the school's energy performance.

Further evaluation of electrical loads may be accomplished by the school computer as shown in Figure 2-7. By segmenting the energy systems into electrical loads, the school computer can be programmed to automatically turn off low priority loads to avoid a new electrical demand peak.

The HVAC summary in Figure 2-8 documents the energy savings from one piece of heating/ventilating/air-conditioning equipment.

Manpower reports—The computer can be set up to schedule and report on the manpower used in maintaining equipment. Maintenance management computer programs allow the supervisor to evaluate schedules, tools, and costs associated with the maintenance of the physical plant.

The scheduling of maintenance may be reviewed by the responsible person through a maintenance schedule summary.

The maintenance scheduling summary in Figure 2-9 documents the maintenance to be performed for the week along with the tools and skill levels required to perform the maintenance.

Associated costs also can be reported with the maintenance management package. See Figure 2-

```
                                        TASK--MATL--TOOL    TYPE    AVG.  ACT.
                                                                    TIME

SUM SUMP PUMPS
  NOR NORTH PLDG      BASEMENT NORTH PLDG
    SUMP PUMP QUARTERLY PM                  0001   0001     CAL      90
                                                                    DISCONNECT CIRCUIT BREAKER
                                                                    STANDARD TOOLS AS REQUIRED
    SUMP PUMP ANNUAL PM                     0002   0001     CAL     240
                                                                    DISCONNECT CIRCUIT BREAKER
                                                                    STANDARD TOOLS AS REQUIRED
  SOU SOUTH PLDG      BASEMENT NORTH PLDG
    SUMP PUMP QUARTERLY PM                  0001   0001     CAL      90
                                                                    DISCONNECT CIRCUIT BREAKER
                                                                    STANDARD TOOLS AS REQUIRED
    SUMP PUMP ANNUAL PM                     0002   0001     CAL     240
                                                                    DISCONNECT CIRCUIT BREAKER
                                                                    STANDARD TOOLS AS REQUIRED
  RMT REMOTE PLDG     BASEMENT NORTH PLDG
    SUMP PUMP QUARTERLY PM                  0001   0001     CAL      90
                                                                    DISCONNECT CIRCUIT BREAKER
                                                                    STANDARD TOOLS AS REQUIRED
    SUMP PUMP ANNUAL PM                     0002   0001     CAL     240
                                                                    DISCONNECT CIRCUIT BREAKER
                                                                    STANDARD TOOLS AS REQUIRED

KIT KITCHEN
  FRE FREEZER         FREEZER 0 1
    FOOD FREEZER RX-101 MONTHLY PM          0007   0201   0003     CAL      15
```

Figure 2-9—Summary of scheduled maintenance.

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MAINTENANCE COST SUMMARY MONTH TO DATE 10/25/79

BUILDING- ALL BUILDINGS SYSTEM- ALL SYSTEMS

	LABOR HOURS	LABOR COST	MATERIAL COST	TOTAL COST
CHL PLANT SYSTEM				
PREVENTIVE MAINTENANCE.	8	55	20	75
PREVENTIVE BREAKDOWN. .	0	0	0	0
BREAKDOWN	0	0	0	0
TOTAL	8	55	20	75
SOU BUILDING				
PREVENTIVE MAINTENANCE.	0	0	0	0
PREVENTIVE BREAKDOWN. .	0	0	0	0
BREAKDOWN	0	0	0	0
TOTAL	0	0	0	0
1 NORTH BUILD.				
PREVENTIVE MAINTENANCE.	0	0	0	0
PREVENTIVE BREAKDOWN. .	0	0	0	0
BREAKDOWN	0	0	0	0
TOTAL	0	0	0	0
RMT BUILDING				
PREVENTIVE MAINTENANCE.	0	0	0	0
PREVENTIVE BREAKDOWN. .	0	0	0	0
BREAKDOWN	0	0	0	0
TOTAL	0	0	0	0
CUS CUSTOMER				
PREVENTIVE MAINTENANCE.	2	10	0	11
PREVENTIVE BREAKDOWN. .	0	0	0	0
BREAKDOWN	0	0	0	0
TOTAL	2	10	0	11
COMPLEX TOTAL				
PREVENTIVE MAINTENANCE.	10	65	21	86
PREVENTIVE BREAKDOWN. .	0	0	0	0
BREAKDOWN	0	0	0	0
TOTAL	10	65	21	86

Figure 2-10—Summary of maintenance costs.

10. The maintenance cost summary performs the simple multiplication and addition of time spent and resources used so the costs for maintenance may be reviewed.

In time, the school computer will find more and more applications in managing maintenance, as well as in scheduling, monitoring, and reporting on equipment operations.

3/Controlling Energy Costs

Most school buildings built before 1970 were not designed with energy conservation in mind. However, energy consumption usually can be reduced by:

- modifying mechanical and electrical systems to make them more efficient;
- eliminating unnecessary energy usage, including wasteful practices and losses due to improper maintenance.

Some steps to energy conservation involve significant capital investment and must be weighed against projected savings in order to determine their real value. However, it usually costs very little to eliminate unnecessary usage—such as by turning off lights in unoccupied rooms and keeping electric motors properly maintained. Any of these smaller steps taken individually save only small amounts of energy. Taken together, however, a great deal of energy consumption can be eliminated by altering behavior patterns, improving maintenance practices, and being constantly sensitive to energy costs.

Every school building should be subjected to a thorough energy audit conducted by a qualified professional. The audit should be designed to identify unnecessary energy losses and to evaluate the costs and benefits of corrective measures. The audit also should provide a cost-benefit analysis of modifications to mechanical and electrical systems, as well as to the building structure itself.

The biggest part of the school energy dollar goes for heating and cooling, so this is the first place to look for savings. It's also important to look at lighting and other electrical systems, domestic hot water, outside air intake, the building structure, and alternative energy sources.

Here are some suggestions for each of these areas, some of which involve significant capital investment and some of which are relatively low in cost.

HEATING, VENTILATING, AND AIR CONDITIONING

Many of the following recommendations for reducing heat loss in cold weather will also apply to heat gain in hot weather. Classroom temperatures typically are reduced to obtain some energy savings. Ways of achieving additional savings by reducing the levels of humidity and ventilation and by additional modifications to the heating system are also worthwhile.

Each building represents a unique situation. Therefore, the suggestions below are general and must be tailored to the building involved.

Also note that legal standards governing school ventilation have been reduced in many states in response to energy problems.

Low Cost Steps

1) Place all thermostats on time clocks to reduce the building temperature when it is unoccupied.

2) Identify areas (such as storage rooms and garages) where heating and cooling are not critical and maintain reduced thermostat settings.

3) Consider closing all outside air dampers during the first and last hours of occupancy.

4) Allow natural humidity variations from 20 to 60 percent in occupied spaces.

5) Limit the use of all portable heaters, fans, and similar equipment.

6) Place exhaust fans on timers so they operate only when necessary to remove fumes or odors.

7) Use exhaust hoods only when the area served is in use.

8) Make full use of window coverings. During heating season, if the sun is not shining in all windows, they should be covered. Under some circumstances, windows may be used to light a room.

9) Where heating involves multiple boilers, operate one at full-load rather than several at partial

load.

10) Operate boilers at lower pressures and temperatures in accordance with the space heating demand.

11) Operate hot water circulating pumps and boilers in spring and winter only as needed.

12) Analyze flue gas periodically and adjust combustion of the boiler to maintain efficient combustion.

13) Inspect boilers to determine if they meet the operating conditions of the manufacturer. This includes inspections for scale deposits, deposits of fly ash or soot, and inspections of door gaskets and linkages. Check boiler stack temperatures and firing nozzles.

14) Inspect furnaces, make-up air units and unit heaters to be sure that heat exchanger surfaces are clean. Check for air leaks. Check exhaust gases. Check fans and motors and bring them up to the manufacturer's operating conditions.

15) Check for obstructions in front of radiators, convectors, and fin tube units. Purge all air periodically from high points of hydronic units. Clean the surfaces of all conductive heat transfer equipment.

16) Inspect all ductwork for leakage and repair. Check for loose insulation in ducts or around access doors. Inspect all dampers to make sure they are clean and well lubricated and replace filters periodically. Clean all coils and seal leaks around coils or casings.

17) Check to make sure that pumps and motors are aligned properly and motors are lubricated. Replace any worn bearings or belts.

18) Keep all fan blades clean. Lubricate all bearings or replace if necessary. Make sure all belts are of proper tension and in good condition. Make sure all discharge outlets are free of dirt and debris.

19) Clean strainers and inspect all pipe insulation; repair or replace if necessary.

20) Inspect all steam piping for leaks. Inspect and repair or replace steam traps as necessary.

21) Reduce all ventilation and exhaust air to the minimum currently allowed by state law.

Significant Investments

1) Consider installing an automatic economy cycle on air-handling units that have cooling coils.

2) Install heat recovery devices for exhausted air.

3) Modify exhaust hoods to use primarily untempered outside air for make-up.

4) Consider installing new low-leakage dampers on all outside air ventilation systems.

5) Add new controls to shut down all outside air when the building is unoccupied.

6) Adjust and balance the entire air distribution system to meet current design criteria.

7) Install boiler stack enconomizer.

8) Preheat heavy fuel oil with waste heat.

9) Reduce boiler blow-down losses.

10) Isolate off-line boilers.

11) Replace boilers that are at or near the end of their useful lives.

12) Replace a large boiler with several smaller boilers.

13) Isolate off-line chillers.

14) Consider shutting off or lowering the temperatures of the reheat coils on terminal reheat systems.

15) In dual duct systems, if either no heating or no cooling is called for, isolate the respective duct and operate as a single duct system with the heating or cooling coil modulating.

16) Consider using demand reset controls on multi-zone systems to regulate the zone dampers so that they are fully open. Also, consider resetting the hot deck and cold deck from the area calling for the most heating or cooling.

ELECTRICAL SYSTEMS

The second largest consumer of energy is illumination and electrical power. When energy was relatively cheap, most schools adopted high illumination levels. With the increasing cost of energy, it has become necessary to investigate alternate methods of illumination.

Electrical energy is also used to power various equipment, which often can be modified to save energy.

While energy can be saved by removing fixtures and lamps, it must be realized lighting is a *system* and should be evaluated fully before changes are made. Also, laws in most states establish illumination standards. For these reasons, professional assistance should be obtained in planning modifications to school lighting systems.

Low Cost Steps

1) Promote the use of lighting only when a room is occupied.

2) Replace old, inefficient lamps.

3) Clean lamps and fixtures periodically.

4) If windows are used for illumination, keep them clean.

5) Consider replacing lamps with lower wattage

lamps providing the same or slightly less illumination.

6) Consider using appropriate lighting levels for different areas of the building. Corridors, for example, do not need as much light as a study area.

7) Consider a photocell on interior lighting next to windows to activate the lights.

8) Consider a photocell or time clock for outdoor lighting.

9) Consider reducing demand charges by relamping lights or rescheduling activities.

Significant Investments

1) Replace all frequently used incandescent lighting with fluorescent lighting or high intensity discharge lamps where feasible.

2) Consider correcting the electrical system power factor if you are being billed for KVA demand.

3) Consider using time clocks to turn off noncritical equipment.

4) Consider installing a load programmer to shed loads in order to reduce demand charges.

See Chapter 23 for more suggestions on maintaining electrical systems.

DOMESTIC WATER

Domestic water heating is a significant portion of the total energy consumed in the schools. There are some rather inexpensive changes that can be made to a water system to reduce the energy consumed.

Low Cost Steps

1) Inspect the water system and repair all leaks, especially those at faucets.

2) Inspect insulation on storage tanks and piping, and repair as necessary.

3) Consider using spring return water faucets.

4) If the water pressure exceeds 45 pounds, consider having the pressure reduced on both hot and cold water.

5) Reduce the hot water temperature.

6) Install flow restrictors on all shower heads.

7) Consider eliminating all hot water circulating pumps or controlling them thermostatically or with a time clock.

8) Disconnect all electric water coolers.

Significant Investment

1) Consider replacing electric water heaters with another energy source.

OUTSIDE AIR

Outside air, whether controlled or by infiltration, is expensive to heat and cool. "Infiltration" is defined as outside air that enters the building through cracks, windows, doors, and other openings in the building. All of this unwanted outside air should be eliminated or reduced to an acceptable minimum.

Low Cost Steps

1) Replace all broken or cracked window panes.

2) Replace all broken or cracked weather-stripping.

3) If cracks are evident around windows, either rehang windows to fit tightly or seal the cracks.

4) Encourage the occupants not to open windows during the heating or cooling season.

Significant Investments

1) Install tight fitting storm windows or thermal glaze.

2) Replace large glazed areas with thermal barrier installations.

BUILDING STRUCTURE

Heat transmitted into or out of a building can be drastically reduced by modifications in the glazing and insulation. Those windows that should be treated first are those exposed directly to the sun or with high levels of reflected light. Decisions to add insulation should involve technical assistance in order to avoid potential problems, such as moisture condensation, and to be sure of selecting the proper type and amount of insulation to be most cost-effective.

Low Cost Steps

1) During the heating season, close all interior shading devices to reduce night time heat losses.

Significant Investments

1) Consider adding a reflective film on all exterior windows subject to direct sunlight to reduce the cooling load.

2) Add draperies or window blinds.

3) Install exterior shading devices.

4) Consider adding new roof deck insulation, especially if your building and its roofing are more than 20 years old.

5) Consider replacing unneeded windows with insulation panels.

6) Use opaque or translucent insulating mater-

ials to block off and thermally seal all unused windows.

7) Consider insulating roofs, floors and walls around areas that are heated or cooled.

ALTERNATE ENERGY SOURCES

Both solar energy and wind energy have tremendous potential to reduce energy costs. The capital expenditure necessary to use this cheap energy is large. However, with the rapidly escalating energy costs, the payback period for implementing one of these systems is becoming less. Alternative energy surveys performed as recently as two or three years ago, and which were unfeasible at that time, may now offer an economical solution to energy problems.

Solar energy is used primarily for domestic water heating and, to a lesser extent, space heating. Solar domestic water heaters have been used throughout the world successfully where energy has been expensive. Implementing a solar heating system requires engineering assistance. There are many things to consider, including collector size, structural support of the collector, orientation, and storage capacity, before the implementation of such a system.

The use of solar space heating is probably best done on new construction, because the cost of retrofitting may be prohibitive. This does not eliminate the possibility of cost effectiveness for certain areas of some buildings. A supplemental heating system will be necessary with every solar heating system.

Photovoltaics and wind energy are primarily used to generate electricity. Additional electricity will be necessary, of course, to provide continuous operation and can be purchased from the local utility company. Often any excess electricity generated can be sold to the local utility. Wind-generated electricity often is not of the same quality as purchased power. Adequate wind velocities are necessary for an economical payback on a wind generating system. Because of the high degree of engineering sophistication required, experienced and qualified assistance should be obtained before implementing such a system.

BUILDING AUTOMATION SYSTEMS

Building automation systems are another way of reducing energy consumption. These are very expensive to install; however, the paybacks on these have been very good, often within three years. A building automation system can be used for the surveillance of all building systems, fostering the most efficient use of energy and manpower. It can be programmed to cycle major equipment, shed loads where billing is on a demand basis, and operate lights at various times of the day, among other functions. Building automation systems are generally used for a large complex of buildings. They vary from a relatively simple design that performs only a few functions to more sophisticated designs that provide security and fire monitoring as well as the monitoring of equipment and environmental conditions.

For more on automation, see Chapter 2, "Using Computers in School Maintenance."

4/Safe Maintenance Practices

Safety has special priority in the public schools. School management must have as its first concern the physical safety of the boys and girls who are required to be there each day. For the maintenance team, this means giving continuous attention to all aspects of the building structure and equipment. It also means that each member of the team must acquire a mind-set—a deep sense of personal concern —that compels him to investigate any suspicious or unexplainable conditions.

In addition to the safety of those who work in and learn in the schools, the maintenance team itself faces, each day, some special circumstances that call for caution. Certain equipment and chemicals, for example, may create perils for the thoughtless or unwary user. It is essential, therefore, that each team member understand the potential perils, the limitations of his tools and the ways of going about his job without creating unnecessary hazards.

In its day-to-day work, the maintenance team is primarily concerned with the use of equipment and materials. What follows are some guidelines for the safety-conscious maintenance team.

1) Aisles and passageways—Keep aisles and passageways clear and in good repair with no obstruction across or in aisles that could create hazards.

2) Compressed air—In using compressed air for cleaning purposes, do not exceed 30 psi and then only with effective chip guarding and personal protective equipment.

3) V-belt drives—Guard the V-belt of all drill presses, including the usual front and rear pulleys, to protect the operator from contact or breakage.

4) Emergency flushing—Where the eyes or body of any person may be exposed to injurious corrosive materials, provide suitable facilities for quick drenching or flushing of the eyes and body within the work area for immediate emergency use.

5) Eye and face protection—Protective eye and face equipment is required where there is a reasonable probability of injury that can be prevented by such equipment.

6) Fan blades—Guard the blades of a fan. The guard should have openings no longer than ½ inch. The use of concentric rings with space between them, not exceeding ½ inch, is acceptable provided they are adequately supported.

7) Fire doors—Do not block fire doors or tie them in an open position. Be sure building settlement is not causing doors to bind in either open or closed position. Locate fusible links for fire doors so as to properly function in case of fire. Do not paint them. Three 3-inch diameter vent holes, cut through the metal only, are required for tin-clad fire doors up to nine feet in height. (An additional vent hole is required for doors from nine feet to 12 feet, 4 inches in height.) Secure the metal covering around the opening with small nails and paint the exposed wood thoroughly.

8) Fire protection—Provide and maintain in an effective operating condition, portable fire extinguishers suitable to the conditions and hazards involved. Conspicuously locate and mount extinguishers where they are readily accessible and do not obstruct or obscure them from view. Give maintenance service to portable extinguishers at least once a year; attach a durable tag securely to show next maintenance or recharge date. In storage area, clearance between sprinkler system deflec-

tors and top of storage varies with the type of storage. For combustible materials stored over 15 feet but not more than 21 feet high in piles that contain horizontal channels, the minimum clearance is 36 inches. The minimum clearance for smaller piles or for noncombustible materials is 18 inches.

9) Flammable liquids—Can be highly hazardous to life and property. Check with local fire department officials for recommendations. Be sure that proper safety containers are available in the school shop finishing area. Bulk flammable liquids and paints should be stored away from the occupied building.

10) Floors—Keep all floor surfaces clean, dry and free from protruding nails, splinters, loose boards, holes or projections. Where wet cleaning is used, maintain drainage; where practicable, provide false floors, platforms, mats or other dry standing places.

11) Hand tools—Keep tools and equipment clean and in safe condition.

12) Housekeeping—Keep clean, orderly, accessible and in a sanitary condition all places of employment, passageways, storerooms, and service rooms.

13) Ladders, fixed—Assure that all fixed ladders will support a minimum concentrated live load of 200 pounds applied at the center of the rung. The minimum diameter of rungs is:

- ¾ inch if metal (in noncorrosive exposure);
- one inch if the ladder is constructed of metal rungs embedded in concrete and exposed to a corrosive atmosphere;
- 1¼ inch if the ladder is wooden.

Spaced no more than 12 inches apart, the rungs should have a minimum clear length of 16 inches. Vertical fixed ladders shall be spaced out from walls to maintain a minimum of seven inches measured from the rung to the wall. Head clearance back of the ladder should allow a minimum of two feet-six inches measured from the rung at right angle to the ladder side rails. Access ladders to elevated platforms shall be extended to a minimum distance of three feet-six inches above that platform (manhole and roof hatch ladders excepted). Paint or treat metal ladders to resist corrosion or rusting when the location demands.

14) Ladders, portable—Equip stepladders with a metal spreader or some locking device of sufficient size and strength to securely hold the front and back sections in open position. Maintain ladders in good condition and withdraw (trash out) defective ladders from service. Erect non-self-supporting ladders on a sound base at a 1:4 slope and secure to prevent slipping. The top of a ladder used to gain access to a roof should extend at least three feet above the point of contact. Coat wooden ladders with a suitable protective material.

15) Stationary electrical devices—Ground all stationary electrical powered equipment tools and devices placed within reach of a person who can make contact with any grounded surface or object.

16) Storage—Stack, block, interlock and limit in height all storage, so that it is secure against sliding and collapse. Keep storage areas free from accumulation of materials that constitute hazards or pest harborage. Exercise vegetation control when necessary. Where mechanical handling equipment is used, allow safe-clearance for aisles, at loading docks and through doorways.

Storage areas and storage procedures should consider the following guidelines:

- Storage areas should be kept orderly and free from accumulation of materials that constitute hazards, whether said hazards are a result of the nature of material stored or careless/disorderly placement of stored materials.
- Organize storage procedures so as to discourage the harboring of pests. Storage should be racked or spaced clear of the floor. Pest control against rodents and termites may become necessary where storage is long term.
- Outside stock storage should be limited to a safe height, enclosed by safeguard fencing and should be spaced a minimum of eight inches free above the earth to discourage pests.
- Check inside storage areas for life safety compliance as to locations and required safety measures.
- Inside storage should be preceded by a determination of floor load capacity and determination of stored material weight.
- Where mechanical handling equipment is to be used, allowances for safe-clearance must be made for aisles, at loading docks and through doorways. Determination of floor load capacities existing and those capacities necessary for storage operations should be considered beforehand.
- Storage should never occupy a non-floored area not suitably separated from occupied spaces.

17) Trash—Collect and remove trash and rubbish in such a manner as to avoid creating a menace to health and as often as necessary for the maintenance of good sanitary and visual conditions.

5/ Designing Buildings for Efficient Maintenance

The design of a building has a direct impact on building maintenance. A building can be designed to make maintenance relatively easy and low in cost. Such things as efficient traffic patterns, strategically located storage areas, and easy access to mechanical equipment can save thousands of dollars every year—over the entire life of the building—by eliminating needless building wear and inefficient maintenance work.

Building materials, too, can be selected for ease of maintenance—a characteristic which can quickly offset a substantially higher first cost. The following inventory is useful for remodeling existing buildings, as well as for building new ones. Generally, the extra one-time cost of installing low maintenance items is recovered in the first few years of operation. The following list is incomplete, but it does offer ideas to be considered for employees and for occupants.

GENERAL

1) Have safety requirements been considered?

2) Is there easy access to all mechanical equipment for maintenance personnel?

3) Is there a separate adequate main custodial storage area?

4) Are there adequate custodial closets on each floor and/or at strategic intervals?

5) Are the doors to all mechanical equipment rooms wide enough to get the equipment in and out?

6) Make adequate provisions for filter cleaning procedures.

7) Is there adequate clearance in boiler areas for use of the cleaning equipment? Is access adequate to allow boiler service?

8) Consider maintenance traffic; does it cross occupant areas? Can this be avoided or minimized?

9) Are there floor-type service sinks with adequate cleanout drains in custodial and other maintenance areas?

10) Where lockers are provided, use lockers with closed bases and slanted tops to minimize cleaning. In athletic locker rooms, consider extended, raised locker bases to provide seating in front of lockers.

11) Before occupying the building, see that complete operational and maintenance manuals are provided for all equipment. Maintenance personnel should be provided with operating instructions.

12) Have adequate floor drains been incorporated in areas subject to water from flushing, runoff, or periodic flooding?

13) Check ventilation in custodial areas.

14) Provide shelving, hooks, lighting, etc. for custodial storage areas.

15) Check lighting and electrical outlets for adequacy. Be certain that receptacle type and capacity match up with cleaning equipment.

16) Review trash removal pattern from the building, including the locations of any elevators.

17) Provide a collection point for trash that is accessible for both delivery and removal.

BUILDING EXTERIOR

1) Consider ramps in place of steps and be sure that people with disabilities have access to the building. Assure compliance with current disability standards.

2) In landscape planning, use low maintenance profile plant materials. Avoid handwork where possible. Lay out walks and plant materials to discourage people from walking on lawns. Landscape plantings should be spaced to accommodate passage of groundskeeping equipment with a minimum of follow-up handwork. Review traffic pat-

terns, such as from parking lots to building entrances.

3) In geographic areas subject to snow and ice, avoid placing major traffic entrances on shady north side of the buildings. Ice and snow removal can be aided by exposure to solar radiation.

4) Provide security type water faucets on building exteriors every 100 feet or so for windows washing, watering plants, etc.

5) Consider emergency access for fire fighting equipment and locate drives, parking, plant materials, and walks accordingly.

6) Is drainage adequate for walks, entrances, lawns, and parking areas? Assure that downspouts do not direct roof water onto sidewalk surfaces which may become a danger when icy.

7) Avoid unprotected subgrade entrance areas.

8) Assure that building subgrade areas within the building are protected from water migration at the exterior wall.

BUILDING INTERIOR

1) Use medium colored floor coverings and choose materials which are readily cleaned and show minimal soil.

2) Use dark baseboards and choose materials that resist scuff marks and resist damage.

3) Where floors are exposed to heavy loads, select floor coverings that can withstand the wear.

4) Avoid interior steps or similar obstacles to the movement of equipment or to the use of cleaning equipment. Assure that steps and ramps are appropriately appointed and marked to meet state and federal regulations for pedestrian and handicapped traffic.

5) Assure that all interior subgrade areas are adequately protected from water infiltration and adequately drained. Non-assignable areas should be adequately drained.

6) Assure that provisions are adequate and proper for compliance with state health codes for preparation and storage of food.

7) Assure that an emergency flushing and shower facility is provided in the chemistry laboratory.

RESTROOMS

1) In planning washrooms, check traffic flow and locate fixtures accordingly. Mirrors and shelves located away from lavatories will aid traffic flow. Provide for handicapped accessibility.

2) Check washroom accessibility in relation to occupant patterns.

3) Assure that toilet facilities and access space are adequate in terms of occupant use with particular attention given the handicapped.

4) Are floor drains adequate?

5) Is there storage for toilet room supplies available within a reasonable distance?

6) Is ventilation adequate?

7) Use nonporous floors, walls, and ceilings which are easily cleaned and do not contribute to fungus growth or conditions creating odors.

8) Use wall-hung urinals, commodes, partitions, wash basins, and sinks. Enclose pipes wherever possible under wash basins. Consider open-throated urinals.

9) Select partitions which are sturdy and fabricated to accommodate cleaning procedures.

10) Provide adequate dispensers for soap, towels, toilet paper. Double toilet paper holders and extra towel cabinets are recommended to reduce time for servicing.

11) Fixtures and mirrors should not be visible from entrance doors.

12) Provide an adquate number of electrical outlets.

13) Because toilet floors are water mopped frequently, make them as free and clear as possible and provide with adequate drainage.

WINDOWS

1) Reduce energy waste (air conditioning and heating losses) by reducing the number of windows and/or using thermal sash and thermal glazing.

2) Reduce dust catching surfaces.

3) Review window cleaning requirements in choosing window types.

WALLS

1) Locate fire alarm signals in recessed, breakable glass wall cases.

2) Review wall cleaning procedures and choose the best type of wall coverings.

3) Use wall-hung water fountains and use protective wall coverings.

4) Use dark baseboards.

5) Assure that drinking fountains meet handicapped accessibility standards.

6) Confirm the location of fire extinguishers.

ELECTRICAL SERVICE

1) Assure that electrical service is adequate and

in compliance with ground fault regulations.

2) Assure all electrical panels are accessible and have proper clearance.

3) Review electrical and lighting systems for energy conservation.

4) Assure that emergency lighting systems are adequate.

5) Review building use and provide an adequate number of outlets to reduce the use of extension cords.

6) Assure that all electric motors are easily accessible for periodic maintenance.

7) Consider the use of key switches in public areas.

8) Assure that lighting is adequate and easy to clean. Is replacement of bulbs convenient?

9) Assure that exit lights are properly located.

10) Assure that exterior lighting is adequate and on automatic control.

11) Review provisions for telephones.

12) Assure that power service outlets and/or receptacles meet intended usage requirements.

FLOORS

1) Stock extra tile of each pattern and color for replacements.

2) All hard floors, such as concrete or terrazzo, should be sealed.

3) Use medium colored floor coverings for ease of daily maintenance.

4) Consider use of carpeting in entrances and elevators to collect and hold soil. Floor recesses for carpet or special shoe cleaning pads are not recommended.

5) Do not use resilient tile floor coverings in areas that are water mopped daily.

6) Assure that floor finish in food handling areas are proper for compliance with the state health codes and readily cleanable and maintainable.

7) Assure that adequate provisions are made for ventilating and drying off of locker rooms adjacent to gang showers.

SPECIAL CONSIDERATIONS

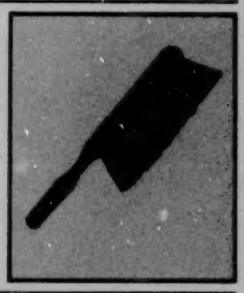
1) Assure that the food service arrangement is efficient and the traffic pattern is adequate.

2) Assure that food service equipment is appropriate, adequate and that installations are in compliance with the state health and sanitation standards and recommendations.

3) Assure that sanitary waste lines are provided with adequate and strategically located cleanouts.

4) Assure that reasonable flexibility in mechanical and electrical installations is considered in school shops and other specialized areas.

Section Two
CLEANING AND GENERAL BUILDING SERVICES



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6/Organizing the Custodial Operation

The regular custodial care of school buildings is essential for several reasons. For one thing, it affects the safety and well-being of all users, including students and teachers. For another thing, it affects the life of the building and its contents and the rate at which they deteriorate.

Custodial care, moreover, has a decided impact on the school's appearance—its image and the attitudes of people who work there, study there, visit, or just drive by.

In order for the maintenance team to meet its important responsibilities within reasonable costs, the manager must ensure that the entire custodial operation is properly organized. For the manager this means:

- Starting with clear goals and policies;
- Organizing work;
- Organizing people;
- Organizing other resources;
- Evaluating the results.

Each of these five managerial steps includes a number of essential considerations.

GETTING STARTED

Policy

A written policy statement that clearly states the goals of the board of education and is acceptable to the administration and most employees is a vital basis for a well-managed maintenance program. See the examples in Figure 6-1.

The board should consult with custodial workers and managers to write a policy that takes into account, as far as possible, the practical problems and concerns of those who will organize and perform the work.

Some goals that should be included in any policy are:

- Schools that are as well-maintained and attractive as possible, using the resources available;
- A fair work load for each employee;
- A standard of professionalism that expects all employees to use initiative and take pride in their work.

The policy should provide written support for the maintenance/custodial program and create conditions that will encourage supervisors and staff to strive for high performance standards. This in turn will provide those using the buildings with the basic conditions they need to excel in teaching and learning.

The school administration must recognize, understand and support the "work management concept" under which workers are trained to take responsibility for the best use of time, equipment, and supplies to accomplish established standards of work performance.

Division of Responsibility

Those who use facilities share responsibility for their upkeep. A written policy outlining this responsibility is helpful. Following are some guidelines:

- Those using classrooms and other facilities should consider those who will use the room after them and should practice such courtesies as leaving an erased chalk board.
- Rules and regulations governing students should include rules concerning the upkeep and appearance of school property, with penalties for violation.
- In some schools, students police areas before they are dismissed, gathering trash and so forth.
- Responsibility for cleaning in special areas, such as laboratories or shop areas, may be shared with the department.
- Window sills cluttered with plants and other items should not be dusted by the custodian.
- Where floor areas are cluttered, only traffic

CUSTODIAL SERVICES

The schools of the district shall be maintained in a sanitary and attractive condition. To this end, an adequate staff of custodians and sufficient supplies and equipment shall be provided.

The custodial staff shall receive direction and supervision in the performance of its tasks. There will be an active inservice training program to increase effectiveness and to introduce new products or methods.

In addition to routine cleaning procedures, more extensive and thorough cleaning of buildings and equipment shall be scheduled for vacation periods, particularly during the summer.

Maintaining a clean and orderly school building is not solely the responsibility of the custodian. All staff members need to be thoughtful and cooperative, not only in their own actions but also in developing standards and habits on the part of the pupils.

BUILDINGS AND GROUNDS MAINTENANCE

The buildings of the school district represent a substantial investment by the community. They shall be maintained in good condition by a continuous program of repair, replacement, and preventive maintenance.

Major work which requires specialized skill or equipment shall normally be performed by outside workers on a contract basis, usually during vacation periods to avoid interference with classes. The superintendent shall submit to the board a descriptive listing of such projects, together with cost estimates and an indication of priority. The board will determine which projects shall be undertaken and will authorize bidding as required.

The services of an architect or other specialist on a consultant basis may be utilized when deemed necessary in making an informed judgment, or to prepare plans and specifications as needed.

Attractively landscaped school grounds are a value to the community.

Figure 6-1—Examples of school board policies.

lanes should be cleaned.

- Custodians should leave each interior door the way they found it—locked or unlocked. It is the responsibility of the occupant of the area to leave doors locked if desired.
- Exterior doors are locked and unlocked according to the supervisor's instructions.
- School policy should be established regarding lost and found items, use of bulletin boards, use of telephones and other school property, and other matters as needed.
- Requests for special custodial services should be made to the supervisor, who will evaluate the need and determine whether the request should be granted.
- Unrelated services, such as running errands, should not be requested of custodians.

Professionalism

Creating a spirit of professionalism among custodial staff is the surest way to insure a high level of work and dependability.

A good training program is the first step in encouraging custodial workers to take a professional attitude, and this should be reinforced by the attitude of managers and other school personnel toward the custodial staff. Staff should be treated as professionals by all school personnel. In addition, custodial workers are entitled to a well-managed and carefully-organized program that ensures a fair workload for all workers and that provides the time and equipment necessary to do a good job.

Professionalism includes:

- Job knowledge, which begins with a training program and continues with judgment and skills gained on the job. Careful supervision is important to ensure the latter.
- Dependability, which includes punctuality, careful reporting, and conscientious carrying out of work.
- Attitude toward work and organization. Good working conditions and proper equipment to do a good job are essential to creating a good work attitude.

All custodial workers should be provided with a clearly-written statement of professional standards, preferably as part of a locally-developed custodial handbook (see Chapter 7 for examples).

Training

Supervisory training—Working supervisors may be crew leaders (an employee who is basically part of the work crew and devotes approximately ten percent of his or her time to supervision) or a foreman whose primary job is supervision.

In either case, special training for supervisors is essential for a well-managed work program. In many cases, supervisors are custodial workers who were promoted to supervisory levels because they were outstanding workers. However, special skills are needed for supervisors.

Normally, a supervisor is knowledgeable about the technical aspects of the work but needs training, for example, in giving instructions to other

workers. Training should include:

- Fundamentals of supervision and the role of the custodial supervisor.
- Communications skills.
- Motivation of workers.
- Scheduling and planning work.
- Making decisions and solving problems.
- Recruitment, selection and orientation of custodians.
- Training and evaluation of custodians.
- Interviewing and counseling of custodians.
- Handling worker complaints and grievances.
- Discipline.

Initial training—All new employees must be trained to perform work to an understood standard. This training should be based on a manual or written program describing the supplies, equipment, tasks, procedures/methods and programs to be followed. For help in producing a local custodial manual, see Chapter 7 and use any of the appropriate material in *Good School Maintenance*.

Training may be done by immediate supervisors, fellow employees, an outside consultant, or a combination.

Continuing training—Continuing training is essential both for workers and supervisors. This consists of periodic refresher training and special training on new topics that arise from time to time, such as use of paid sick time, communications, sexual harassment, and so forth.

In addition, selected custodians and supervisors should be sent at least once a year to conferences or workshops for training and ideas.

Special training—Whenever a new piece of equipment, a new product or new policy is introduced, special training should be provided by supervisor, vendor, consultant, or member of the administrative staff.

Sources of training—Training programs and materials are available from a variety of sources, including:

- nearby universities. In Illinois, for example, the University of Illinois Operations Section in Champaign conducts frequent programs on sanitation management and can loan video tapes and other materials to school districts. Basic custodial training lessons are available through the PLATO system.
- many manufacturers who want their products used properly offer various types of instruction. Many vendors also have access to the many audio-visual programs produced by the International Sanitary Supply Association.
- associations of custodial and grounds maintenance supervisors. One such organization that offers publications, workshops, and career development programs is the Environmental Management Association, 1019 Highland Avenue, Largo, Florida 33540.

ORGANIZING WORK

General Maintenance Tasks

General building maintenance tasks can be organized into *daily, periodic,* and *special task* groupings. This list is not all inclusive and other tasks may be added:

1) Daily tasks

a) Floors
- Wet clean toilet floors
- Vacuum carpets
- Dust mop most hard and soft floors
- Entrances

b) General dusting
c) Waste removal
d) Clean inside glass and mirrors
e) Clean fixtures (water fountains, toilet)
f) Clean chalkboards
g) Spot and emergency cleaning
h) Close windows and turn off lights
i) Lock and unlock doors
j) Report repairs needed

2) Periodic tasks

a) Floor sealing
b) Floor refinishing
c) Floor buffing
d) Carpet spotting
e) Carpet shampooing
f) Carpet pile lifting
g) Window washing
h) Screen cleaning
i) Venetian blind cleaning
j) Drapery cleaning
k) Wall washing
l) Furniture waxing
m) Upholstery vacuuming
n) Swimming pool cleaning
o) Snow removal

3) Special or seasonal tasks

a) Lawn care
b) Tree care
c) Shrub care
d) Heating and ventilation responsibilities
e) Painting
f) Training
g) Limited furniture moving and repair
h) Limited setups
i) Sanitary napkin vending operation

j) Limited custodial supply delivery
k) Limited supply and equipment testing

Task Responsibilities

Organize task responsibilities in writing so that workers know what they are responsible for and how their tasks interrelate. In a school, the general building maintenance responsibilities might be listed as follows:

1) Routine sweeping and/or mopping of floors; the dusting of trim, furniture, tops of desks and tables (when free of material and/or apparatus), bookcase glass, window ventilators, telephones, desk lamps; the emptying of independent, floor-type waste containers, ashtrays, and disposal of debris.

2) Periodic cleaning, buffing, and finishing of floors and the cleaning of windows and blinds.

3) Cleaning of blackboards (unless otherwise requested), chalk trays, and the replacement of chalk and erasers as necessary.

4) Closing and locking all windows.

5) Cleaning of drinking fountains and all plumbing fixtures.

6) Furnishing of materials and supplies required for the above and the supply of toilet paper, towels, and liquid hand soap where dispensers are installed.

7) Collection and removal of trash.

8) Cleaning of mirrors and interior glass.

Routine Task Procedures

It is essential that persons performing any given task understand in detail all of the procedures that are involved. He must know, for example, such things as:

- What the task is intended to accomplish.
- How the task is to be performed.
- Standard of cleanliness required.
- Frequency of the task.
- Equipment and supplies needed and how they are used.
- Any safety or other considerations.

The procedures suggested for most routine tasks commonly called for in any public school are set forth in Chapter 9.

Cleaning Principles

Some cleaning principles useful in guiding members of the building maintenance staff are as follows:

1) Cleaning personnel and their work are important.

2) Productive cleaning is programmed when the area to be cleaned is vacant or has a period of low occupancy.

3) The established standard of cleaning must be appropriate to the area being served if reasonable costs are to be achieved.

4) Occupants' habits have a direct affect on the standard of cleanliness and costs.

5) Inadequate cleaning facilities increase cleaning costs by increasing unproductive time.

6) Modern management concepts must be used.

7) Avoid using custodial personnel for personal tasks or errands, since this results in unproductive time, excessive costs, and dirty buildings.

8) Make the job as interesting as possible by including various types of tasks in one work assignment.

Standard of Cleanliness

To organize and achieve the desired standard of cleanliness, the following items must be considered:

1) The standard of cleanliness must be appropriate to the area serviced.

2) The standard of cleanliness must avoid overcleaning, as well as undercleaning.

3) It should be understood that cleaning for appearance is expensive.

4) The standard of cleanliness is based primarily on:

- Service performed
- Frequency of that service
- Work skills
- Habits of occupants

Organization of Time

The best time to schedule maintenance is during periods when the area is vacant or has low occupancy. For example, clean and refinish the floors during school vacation periods.

Unscheduled or emergency work should be done based on need and urgency. Each need must be studied and a decision made for best cost results.

Establishing Frequencies

How often should a floor be swept? Scrubbed? How often should light fixtures be cleaned? Frequencies must be determined by the custodial manager based upon such factors as the standard of cleanliness desired, occupant usage of the area, and the availability of custodial staff.

A helpful way to begin planning is to produce a table of task frequencies such as the example in

WORK SHEET—DETERMINING FREQUENCIES FOR CLEANING AND SERVICES

Use the legend below to indicate how often each task must be performed in each area of the school.

AREAS / TASKS																				
Cafeteria	AN			5W	5W	5W	AN	1W	A	5W	A3	AN	5W	1M	1W	1W	AN	AN	SA	AN
Classrooms			5W		5W	5W	AN	1W	A		A5	AN	5W	A	VP	SA	3W	AN	SA	AN
Corridors	AN				5W	5W	AN	1W	A	5W	A3	AN	5W	A	1M	3M	5W	AN	SA	AN
Entrances					5W	5W	AN	5W	SA	5W	A3	AN	5W	A	1W	1M	5W	AN	1W	AN
Gymnasiums			5W	5W	5W	5W	AN	1W	A	5W	A5	AN	5W	A	AN				SA	AN
Laboratories		AN	5W	5W	5W	5W	AN	1W	SA	5W	A5	AN	5W	A	VP	3M			SA	AN
Library, Music Room			5W		5W	5W	AN	1W	A		A3	AN	5W	A	VP	SA	3W	AN	SA	AN
Locker/Shower Rooms	AN				5W	5W	AN	1W	A	5W	A3	5W	5W	A	1M	1M			SA	AN
Offices			5W		5W	5W	AN	1W	A		A5	AN	5W	A	SA	A	2W	AN	SA	AN
Restrooms				5W	5W	5W	AN	1W	A	5W	A3	5W	5W		1M	1M			SA	AN
Shops			5W		5W	5W	AN	1W	SA	5W	A5	5W	5W	A	VP	A			SA	AN
Stairways					5W	5W	AN	1W	A		A3	AN			1M	A			SA	AN
Swimming Pool	AN			5W	5W	5W	AN	1W	A	5W	A5	5W	5W		AN	A			SA	AN

5W—Five times a week
4W—Four times a week
3W—Three times a week
2W—Twice a week
1W—Once a week

3M—Three times a month
2M—Twice a month
1M—Once a month
Q—Quarterly
SA—Semi-Annually

A—Annually
A3—Every three years
A5—Every five years
AN—As needed
AU—After every use
VP—During vacation periods

Figure 6-2—Custodial managers can use these suggested frequencies as a guide until local experience shows more clearly how often various tasks need to be performed in each area of the school. A work sheet similar to this table is available in the Management Tools Appendix.

Figure 6-2. A full-size blank table is provided in the Management Tools Appendix. The manager can use the frequencies suggested in Figure 6-2 as a starting point and modify them based on experience. Listing the frequencies in a single table will make it easier for the manager to grasp the total workload that must be allocated to the custodial staff.

Time Standards

There are many uncontrollable variables in custodial services caused by such items as the building (design, use, age, state of repair), custodial facilities, undefined responsibilities, purchasing regulations, personnel aspects, union agreements, benefits, untrained supervision, occupant demands, building size, and geographic location. However, the following organization of time appears to be a reasonable starting place with the understanding that *locally developed standards are the best.* Well-managed programs in large buildings should do better than this guide.

1) Based on once-a-day frequency and a five-day school week, an *institutional standard of cleaning* is possible using 125 to 200 annual man hours per 1,000 square feet (gross) of floor space.

2) The tasks listed on page 24 under "General Maintenance Tasks" include custodial services and their suggested frequency and represent the general cleaning needs for school buildings. While it must be understood that the list is not all inclusive, with proper local management it should be adequate for most school buildings.

3) A dollar value is reached by multiplying 125 to 200 times the average hourly custodial pay rate

for the particular institution, times the number of units of 1,000 gross square feet of floor space. The dollar value represents all normal custodial costs.

Here is an example of a Task Time Breakdown, based on 150 man hours per 1,000 gross square feet:

Services	Time %	Man hours per 1,000 sq. ft. (gross)
Floors (daily)	20	30
Floors (periodic)	20	30
Dusting	8	12
Waste removal	10	15
Glass cleaning	7	10.5
Fixture cleaning	12	18
Entrance cleaning	2	3
Furniture waxing	1	1.5
Locking/unlocking	2	3
Closing/raising windows, etc.	1	1.5
Repairs reporting	3	4.5
Spot cleaning	1	1.5
Wall washing	1	1.5
Miscellaneous	12	18
	100%	150

ORGANIZING PEOPLE

Personnel Coordination

To properly organize people, the manager must coordinate work crews with area cleaning assignments (or stations). There usually are several possible combinations of crews/areas/assignments, one of which is bound to be most efficient.

Fair work loads, as well as productivity, depend on proper organization. Since work loads vary, it might be best to organize work arrangements along these lines:

1) Use large areas where one person performs most, if not all, of the services. (This represents an area or station cleaning assignment.)

2) Use back-up crews to fill in area or station vacancies first and to perform periodic work (such as window washing or floor maintenance) when they are not needed for areas or stations.

Custodial Assignment

Each custodial assignment should provide the worker with a written plan outlining work sequence, time schedule and approximate time needed for each specific job. Assignments should be based on an established schedule that allows buildings to be cleaned with minimum inconvenience to users.

Custodians should be encouraged to use common sense and understanding in completing jobs, and they should deviate from the written assignment as needed. However, if certain deviations from the assigned work sequence reoccur, the assignment should be changed.

Periodic cleaning—such as wall washing or furniture waxing—normally is not included in the written schedule, but is done when time is created via work-management techniques taught during training.

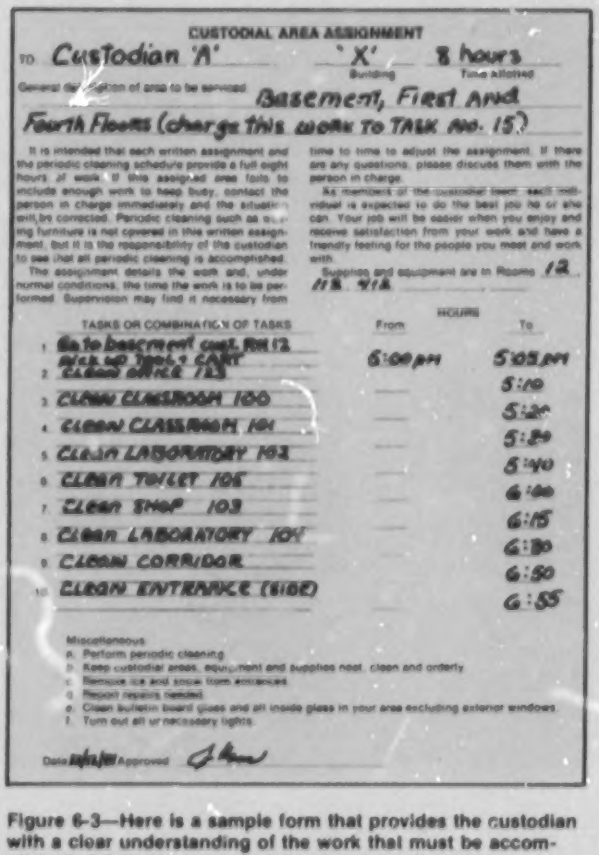
Any problems arising with assignments should be discussed with a supervisor.

A sample Custodial Area Assignment form is provided in the Management Tools Appendix. Figure 6-3 shows how the same form might look when filled out.

ORGANIZING OTHER RESOURCES

Budget Organization

The financial plan or guide is the major control over other considerations in maintenance, so that budget flexibility should be encouraged along with



CUSTODIAL AREA ASSIGNMENT

TO: Custodian 'A' — 'X' (Building) — 8 hours (Time Allotted)

General description of area to be serviced: Basement, First And Fourth Floors (charge this work to Talk No. 15)

It is intended that each written assignment and the periodic cleaning schedule provide a full eight hours of work. If this assigned area fails to include enough work to keep busy, contact the person in charge immediately and the situation will be corrected. Periodic cleaning such as waxing furniture is not covered in this written assignment, but it is the responsibility of the custodian to see that all periodic cleaning is accomplished.

The assignment details the work and, under normal conditions, the time the work is to be performed. Supervision may find it necessary from time to time to adjust the assignment. If there are any questions, please discuss them with the person in charge.

As members of the custodial team, each individual is expected to do the best job he or she can. Your job will be easier when you enjoy and receive satisfaction from your work and have a friendly feeling for the people you meet and work with.

Supplies and equipment are in Rooms 12, 118, 118

TASKS OR COMBINATION OF TASKS	HOURS From	To
1. Go to basement coat room pick up tool cart	6:00 PM	5:05 PM
2. Clean office 113		5:10
3. Clean classroom 100		5:20
4. Clean classroom 101		5:30
5. Clean laboratory 102		5:40
6. Clean toilet 105		6:00
7. Clean shop 103		6:15
8. Clean laboratory 104		6:30
9. Clean corridor		6:50
10. Clean entrance (side)		6:55

Miscellaneous

a. Perform periodic cleaning
b. Keep custodial areas, equipment and supplies neat, clean and orderly
c. Remove ice and snow from entrances
d. Report repairs needed
e. Clean bulletin board glass and all inside glass in your area excluding exterior windows
f. Turn out all unnecessary lights

Date 8/15/80 Approved J. Hess

Figure 6-3—Here is a sample form that provides the custodian with a clear understanding of the work that must be accomplished. A full-size version of the form is available in the Management Tools Appendix.

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responsible management. Rigid budgets stymie leadership, stop needed improvement, and tend to stagnate the operation. Expect all members of the maintenance team to produce and operate an economical program.

Custodial studies indicate, in general, that the cleaning dollar is divided as follows:

- 90 to 95 percent for labor
- 5 to 10 percent for material and equipment

Unfunded Projects

The supervisors of the maintenance program are responsible for the total program, even though it may not be fully funded. If funds are not available for needed projects, such as spring cleaning work, special carpet care, painting, landscaping and so forth, project statements should be developed, containing the following information: work needed, resources needed (material, equipment, manpower), when it should be scheduled, how it should be accomplished and so forth.

The projects should be filed in order of priority, so that when funds become available, the top priority project can be removed from the file, updated, and implemented.

All operations should have a list of written projects awaiting funding. The list should be reviewed at least once a year, with projects added and deleted and priority order changed, as needed.

Contracting

All custodial operations supervisors should have the flexibility to use either in-house or contract personnel to perform maintenance work.

Specialized work often can be done more quickly or at lower cost by a contractor who does such work regularly and has the necessary equipment and skilled employees. Examples include electrical work, plumbing, exterior high-rise window washing, and tile work.

Contracts should be awarded on a competitive basis.

All work that can be done in-house at costs competitive with those charged by contractors should be done by in-house staff.

Equipment and Supplies

The right equipment in the proper amount at the right place at the right time (and in good condition) is necessary for productive cleaning. Assign specific responsibility for equipment and supplies. Remember, unused equipment represents a poor investment and reflects unfavorably on everyone. Also, professional custodians know how to use all types of equipment productively. This is part of their skill and work knowledge.

The basic supplies and equipment and how they are used in school cleaning are presented in Chapter 10.

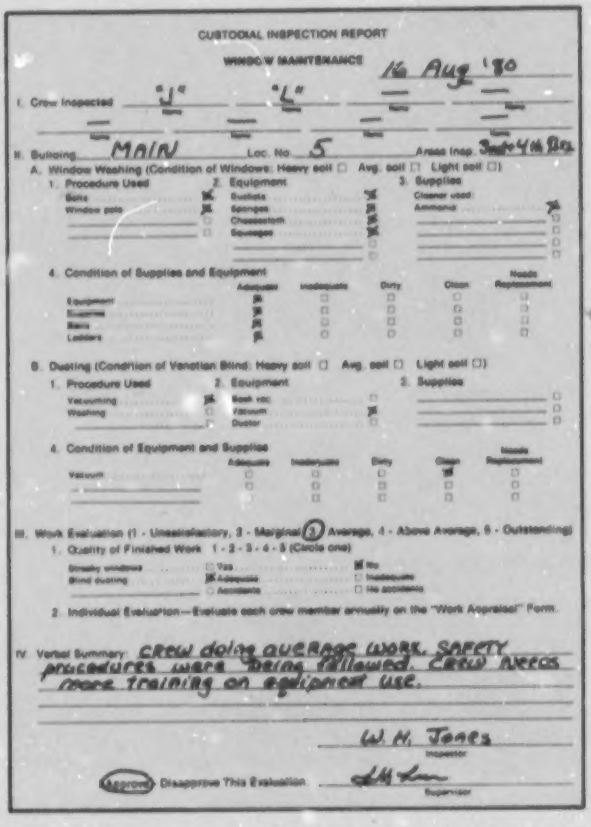
A form that custodians can use to order needed supplies is provided in the Management Tools Appendix.

EVALUATING RESULTS

Work Inspections

Work inspections may be formal or informal, but the philosophy is the same for all inspections, and that is "to help everyone do a better job." In general, this means the supervisor should compliment good work, and not disregard but seek improvement in poor work.

A personal visit to the work area remains one of the best controls. Such a visit is most helpful when it results in written information on work, equipment, supplies, etc. Among other things, these reports provide a basis for future inspections, because they point out weak and strong points.



CUSTODIAL INSPECTION REPORT

WINDOW MAINTENANCE

16 Aug '80

I. Crew Inspected: "J" "L"

II. Building: MAIN Loc. No: 5 Areas Insp.

A. Window Washing (Condition of Windows: Heavy soil ☐ Avg. soil ☐ Light soil ☐)

1. Procedure Used: Sinks ☒ Window pots ☒
2. Equipment: Buckets ☒ Sponges ☒ Cheesecloth ☒ Squeegee ☒
3. Supplies: Cleaner used: Ammonia ☒

4. Condition of Supplies and Equipment

	Adequate	Inadequate	Dirty	Clean	Needs Replacement
Equipment	☒	☐	☐	☐	☐
Supplies	☒	☐	☐	☐	☐
Basic	☒	☐	☐	☐	☐
Ladders	☒	☐	☐	☐	☐

B. Dusting (Condition of Venetian Blind: Heavy soil ☐ Avg. soil ☐ Light soil ☐)

1. Procedure Used: Vacuuming ☒ Washing ☐
2. Equipment: Sock vac ☐ Vacuum ☒ Duster ☐
3. Supplies

4. Condition of Equipment and Supplies

	Adequate	Inadequate	Dirty	Clean	Needs Replacement
Vacuum	☐	☐	☐	☒	☐

III. Work Evaluation (1 - Unsatisfactory, 2 - Marginal, (3) Average, 4 - Above Average, 5 - Outstanding)

1. Quality of Finished Work 1 - 2 - 3 - 4 - 5 (Circle one)

Streaky windows: ☐ Yes ☒ No
Blind dusting: ☒ Adequate ☐ Inadequate
Accidents: ☐ No accidents

2. Individual Evaluation—Evaluate each crew member annually on the "Work Appraisal" Form.

IV. Verbal Summary: Crew doing average work. Safety procedures were being followed. Crew needs more training on equipment use.

W. H. Jones
Inspector

(Approve) Disapprove This Evaluation

Supervisor

Figure 6-4—Here is a sample form for reporting the inspection of window maintenance. A full-size version of the form is available in the Management Tools Appendix.

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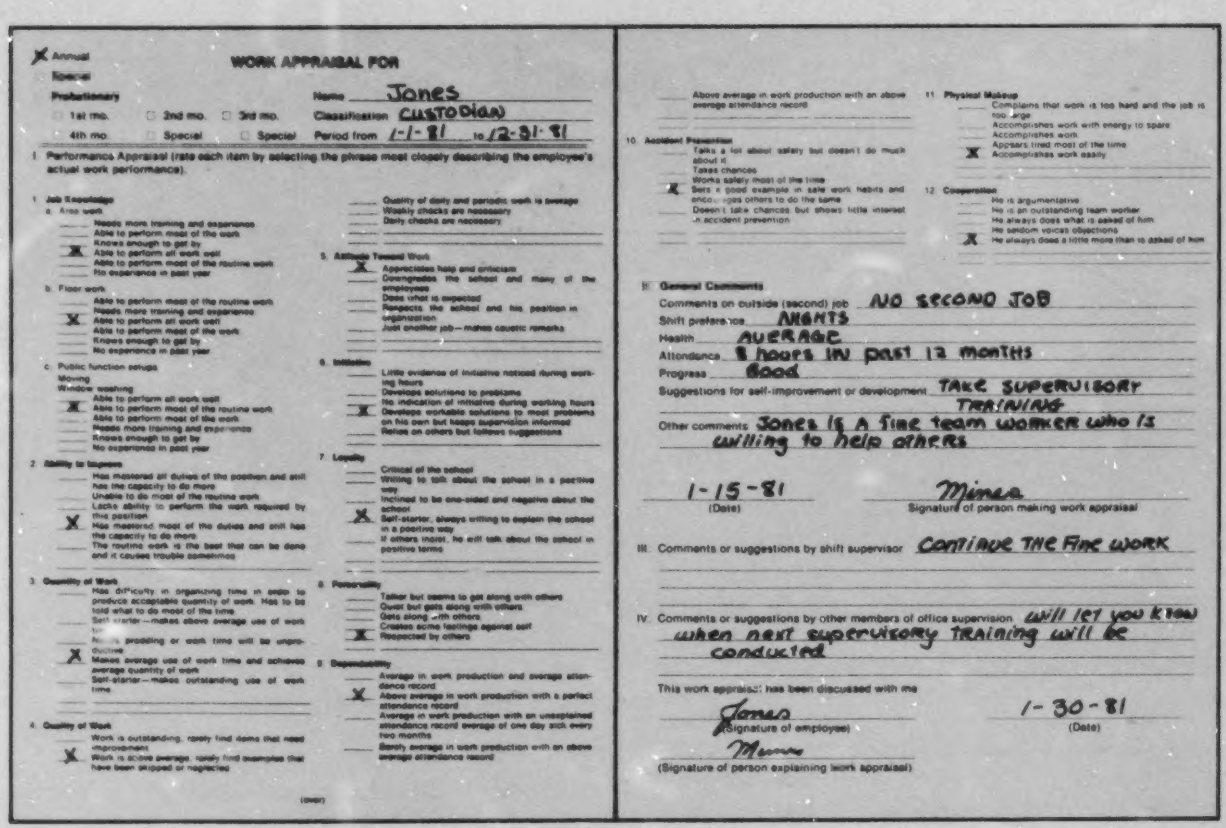

X Annual
Special
Probationary
1st mo. 2nd mo. 3rd mo.
4th mo. Special Special

WORK APPRAISAL FOR

Name Jones
Classification CUSTODIAN
Period from 1-1-81 to 12-31-81

I Performance Appraisal (rate each item by selecting the phrase most closely describing the employee's actual work performance).

1. Job Knowledge
a. Area work
Needs more training and experience
Able to perform most of the work
X Knows enough to get by
Able to perform all work well
Able to perform most of the routine work
No experience in past year

b. Floor work
Able to perform most of the routine work
Needs more training and experience
X Able to perform all work well
Able to perform most of the work
Knows enough to get by
No experience in past year

c. Public function setups
Moving
Window washing
X Able to perform all work well
Able to perform most of the routine work
Able to perform most of the work
Needs more training and experience
Knows enough to get by
No experience in past year

2. Ability to Improve
Has mastered all duties of the position and still has the capacity to do more
Unable to do most of the routine work
Lacks ability to perform the work required by this position
X Has mastered most of the duties and still has the capacity to do more
The routine work is the best that can be done and it causes trouble sometimes

3. Quantity of Work
Has difficulty in organizing time in order to produce acceptable quantity of work. Has to be told what to do most of the time
Self-starter—makes above average use of work time
Needs prodding or work time will be unproductive
X Makes average use of work time and achieves average quantity of work
Self-starter—makes outstanding use of work time

4. Quality of Work
Work is outstanding, rarely find items that need improvement
X Work is above average, rarely find examples that have been skipped or neglected
Quality of daily and periodic work is average
Weekly checks are necessary
Daily checks are necessary

5. Attitude Toward Work
X Appreciates help and criticism
Disparages the school and many of the employees
Does what is expected
Respects the school and his position in organization
Just another job—makes caustic remarks

6. Initiative
Little evidence of initiative noticed during working hours
Develops solutions to problems
No indication of initiative during working hours
X Develops workable solutions to most problems on his own but keeps supervision informed
Relies on others but follows suggestions

7. Loyalty
Critical of the school
Willing to talk about the school in a positive way
Inclined to be one-sided and negative about the school
X Self-starter, always willing to explain the school in a positive way
If others insist, he will talk about the school in positive terms

8. Personality
Talker but seems to get along with others
Quiet but gets along with others
Gets along with others
Creates some feelings against self
X Respected by others

9. Dependability
Average in work production and average attendance record
X Above average in work production with a perfect attendance record
Average in work production with an unexplained attendance record average of one day sick every two months
Barely average in work production with an above average attendance record
Above average in work production with an above average attendance record

10. Accident Prevention
Talks a lot about safety but doesn't do much about it
Takes chances
Works safely most of the time
X Sets a good example in safe work habits and encourages others to do the same
Doesn't take chances but shows little interest in accident prevention

11. Physical Makeup
Complains that work is too hard and the job is too large
Accomplishes work with energy to spare
Accomplishes work
Appears tired most of the time
X Accomplishes work easily

12. Cooperation
He is argumentative
He is an outstanding team worker
He always does what is asked of him
He seldom voices objections
X He always does a little more than is asked of him

II General Comments
Comments on outside (second) job NO SECOND JOB
Shift preference NIGHTS
Health AVERAGE
Attendance 8 hours IN past 12 months
Progress Good
Suggestions for self-improvement or development TAKE SUPERVISORY TRAINING
Other comments Jones IS A fine team WORKER who IS willing to help others

1-15-81 (Date)
Mines Signature of person making work appraisal

III. Comments or suggestions by shift supervisor CONTINUE THE FINE WORK

IV. Comments or suggestions by other members of office supervision WILL LET YOU KNOW when next supervisory training will be conducted

This work appraisal has been discussed with me
Jones (Signature of employee)
1-30-81 (Date)
Mines (Signature of person explaining work appraisal)

(over)

Figure 6-5—Here is a sample work appraisal form. A full-size version of the form is available in the Management Tools Appendix.

Sample inspection reports are presented in the Management Tools Appendix. Figure 6-4 shows how one such form might look when filled out.

In addition to the examples provided, some school districts effectively use "occupant reports" to help determine how teachers and others feel about the level of maintenance services. Such reports may or may not depend upon a particular form. If a form is desired, it is best developed locally.

Work Appraisal

Every custodian should receive a formal work appraisal at least once a year. The appraisal should be used to help workers improve their work, and should not be used as a basis for merit salary increases. A Work Appraisal Form is provided in the Management Tools Appendix.

Figure 6-5 shows how a work appraisal form might look when filled out.

The appraisal should include job knowledge, quality of work, and such factors as initiative, loyalty, attitude, and so forth. Attendance is an important indicator of reliability.

Supervisors should discuss appraisals with employees, pointing out where improvements can be made and complimenting good work.

Controls and Reports

In even the smallest school operation, some form of control is essential to see that work is properly and fairly assigned and that it is completed satisfactorily. While much of this is accomplished through personal supervision and inspection, accurate communication and record keeping depends heavily on an efficient system of written instructions and reports.

It is possible to rely too heavily on written reports. Such reports, for example, are no substitute for positive personal interaction between the supervisor and those who work for him. The human element is essential in such aspects of supervision as training, instructing, and correcting. Moreover, excessive use of written reports becomes counterproductive whenever the time spent filling out a form becomes greater than the time saved by increased control.

There are, however, certain kinds of reports

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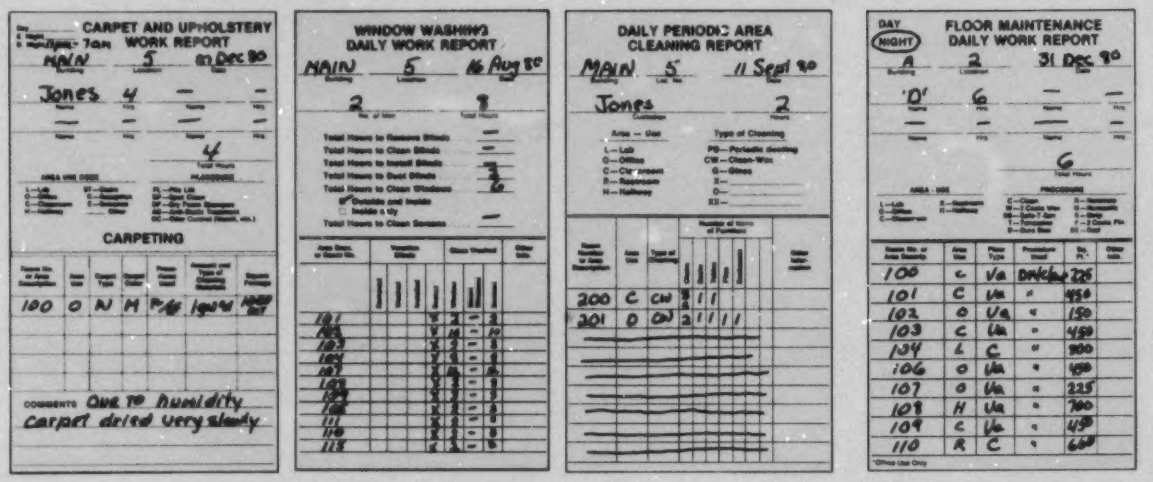

Figure 6-6—Here is how some daily and periodic work reports might look when filled out. Full-size forms are available in the Management Tools Appendix.

which are extremely useful in getting routine information to and from members of the maintenance team. These reports save time, provide information essential to effective management control, and need not be a burden on the total team effort if everyone understands how and why they are used.

Experience shows that the following report forms are effective in most school maintenance operations:

- Custodial Area Assignment (see Figure 6-3)
- Work Reports (daily or periodic) for area cleaning, floor maintenance, window washing, carpet and upholstery work, and supply orders. Figure 6-6 shows how such forms might look when filled out.

Forms for these reports are provided in the Management Tools Appendix.

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7/Creating a Local Handbook for Custodians

Every school district should have its own handbook for use by individual members of the custodial staff. The local handbook forms the basis for training programs for custodians and should be used by all employees as a daily reference in performing their jobs.

This section of *Good School Maintenance*—"Cleaning and General Building Services"—contains most of the material needed to produce a handbook tailored for local use. For a typical local handbook, materials provided here can be adapted to provide such information as the following:

1) Introduction and statement of professional standards. See samples in Figure 7-1.

continued on page 33

INTRODUCTION FOR A CUSTODIAL HANDBOOK

This handbook has been prepared by School District _____ for use by all members of the custodial staff. It includes material of a general nature, such as standards of professionalism, skill and training expected of custodial workers, and general operating matters. It also includes essential reference materials, including copies of forms for reporting work done and repairs needed, as well as sections defining terms often encountered in custodial work and descriptions of the equipment and supplies commonly used.

The two sections entitled "Area Cleaning Programs" and "Procedures-Services" provide step-by-step instructions for efficient, productive work, and should be followed as closely as possible. The instructions include realistic time guidelines that should be met as a general rule. From time to time, circumstances may make it impossible for the instructions to be followed exactly or for time guidelines to be met. If such changes in the written instructions are necessary on a regular basis, the supervisor should be consulted.

All members of the custodial/maintenance staff should review this manual regularly and use it as a guide in carrying out their assignments.

STATEMENT OF PROFESSIONAL STANDARDS

The "face" the schools show to teachers, students and visitors depends upon the work you do. Many visitors will receive their entire impression of the schools from the standards of cleanliness and orderliness maintained by the custodial staff. More importantly, the effectiveness of the educational program depends largely upon safe, orderly surroundings that allow students and teachers to concentrate upon their work.

You are a member of a professional team whose difficult job it is to achieve the highest possible standards of cleanliness and maintenance with limited resources.

Because of this, it is essential that every member of the custodial team take a professional attitude that will result in a high level of productiveness and efficiency.

Professionalism includes the following qualities:

Job knowledge—This is based on the initial training you received and the continuing training opportunities that will be made available to you. It includes skills needed to use supplies and equipment, but it also includes ability to manage time and to exercise judgment in following instructions.

Dependability—Dependability includes being on time for work, giving a full day's work, proper reporting, and fair use of benefits. It also includes efficient use of time to complete a job as quickly and thoroughly as possible, following organizational

Figure 7-1—Here are examples of an "Introduction" and a "Statement of Professional Standards" that can be adapted for the local custodial handbook.

Figure 7-1 *continued*

policies and rules and working safely. The custodial worker is part of a team, and the efficient operation of the team depends upon the reliability of each member.

Attitude—The professional takes a positive attitude toward his or her work, and toward the organization. Attitude includes interest in the job, initiative in making suggestions and improving work, and loyalty to the school. A positive, professional attitude is essential for the worker who wants to grow and to advance in the job.

Initiative—The professional custodian must be prepared to exercise judgment and adapt procedures and working patterns to deal with the unexpected. For example, if an area to be cleaned is in use, another area may be cleaned first. Such 'emergencies' as broken glass, spilled liquids or other hazardous conditions must be dealt with frequently. Any regular or major changes in assignment must be discussed with the supervisor, but day-to-day alterations made to cope with special circumstances should be made at the judgment of the custodian.

In addition, professional workers will use initiative to suggest improvements in procedures that will save time or money, and will look for ways to upgrade standards of maintenance using existing resources.

CUSTODIAL REGULATIONS

Bulletin boards

The custodian is responsible for keeping bulletin boards neat and orderly, removing all outdated material at regular intervals. Signs and other notices are to be posted on bulletin boards *only*—never on doors, glass or walls.

Lost and found

All items of value found in public areas (such as classrooms, hallways or rest rooms) are to be tagged and turned in to the supervisor daily. Lost and found items are not to be stored on the custodial cart or in custodial storage areas. See Figure 7-3.

Telephones

School telephones are to be used only for school business except in cases of emergency. Personnel should not be called to the telephone for incoming personal calls, but should be notified of the call.

Ordering and delivering supplies

Cleaning supplies and materials are ordered and delivered on an established schedule which is posted in the custodial storage room.

Supplies should be stored as follows:

Upper shelves: cloth and/or paper towels, toilet tissue, sanitary bags, other paper items.

Middle shelves: dusters and mopheads, chalk, cheesecloth, erasers and so forth.

Lower shelves: Liquid products.

This arrangement protects dry materials from liquid spills or leaks. Keeping the storage room clean is the responsibility of everyone using the area.

Building security

Buildings are to be locked and unlocked at the appointed hours.

All windows are to be closed and locked as the custodian cleans the area. Blinds are to be left at an even height.

Interior doors are to be left locked or unlocked, as found. It is the responsibility of the occupant of the area to keep doors locked, if desired.

No one is to be allowed into a locked area without authorization.

All office transom windows are to be screwed shut or blocked.

All school equipment is to be inventoried and numbered. Inventory should be updated once a year.

Locks should be changed periodically, and keys signed out to users and recalled when personnel leave.

Money and other valuables should never be left unattended.

The last person to leave an area is responsible for securing the area and locking the door.

(**Note:** Cleaning scheduled at night or on weekends will enhance building security.)

Personal use of school property

Board of Education policy provides that no one connected with the school in any capacity shall use any school property for personal purposes and that no one shall be permitted to remove from the building or grounds any property belonging to the school—even though it may seem to be of no value—unless it is temporarily removed in accordance with some well-established regulation or with the approval of the appropriate administrator.

The rule is intended to cover all types of school property, including vehicles and general supplies.

Figure 7-2—The local custodial handbook should include all applicable regulations, such as the examples suggested here.

2) Statement of overall maintenance policy. This policy states the board of education's goals and objectives for the maintenance program and provide managers with firm guidelines for planning work to be done. It must be developed locally. The handbook may also include specific policies or regulations regarding use of school property, lost and found items, and other important matters. Figure 6-1 (Chapter 6) presents a typical school board policy. Figure 7-2 suggests some sample regulations on specific matters.

3) Area cleaning programs. The step-by-step programs suggested in Chapter 8 should be given several "trial runs" and necessary modifications in procedures and time guidelines should be incorporated into the local handbook.

4) Procedures and services. Material in Chapter 9 should be modified and incorporated as suggested above.

NOTE: Area Cleaning Programs and Procedures-Services may be printed on heavy cards, punched and hung on a ring or hook from the custodial cart for convenient reference.

5) Equipment and supplies. See Chapter 10 for material that can be adapted for the local handbook.

6) Glossary of terms. See Chapter 11.

7) Landscaping and Grounds Maintenance. See Section Four; modify if necessary.

8) Forms. See the Management Tools Appendix. These forms may be copied in bulk or modified and reprinted for local use. Local handbooks should include samples of the forms along with instructions for using them. Reporting instructions must be developed locally.

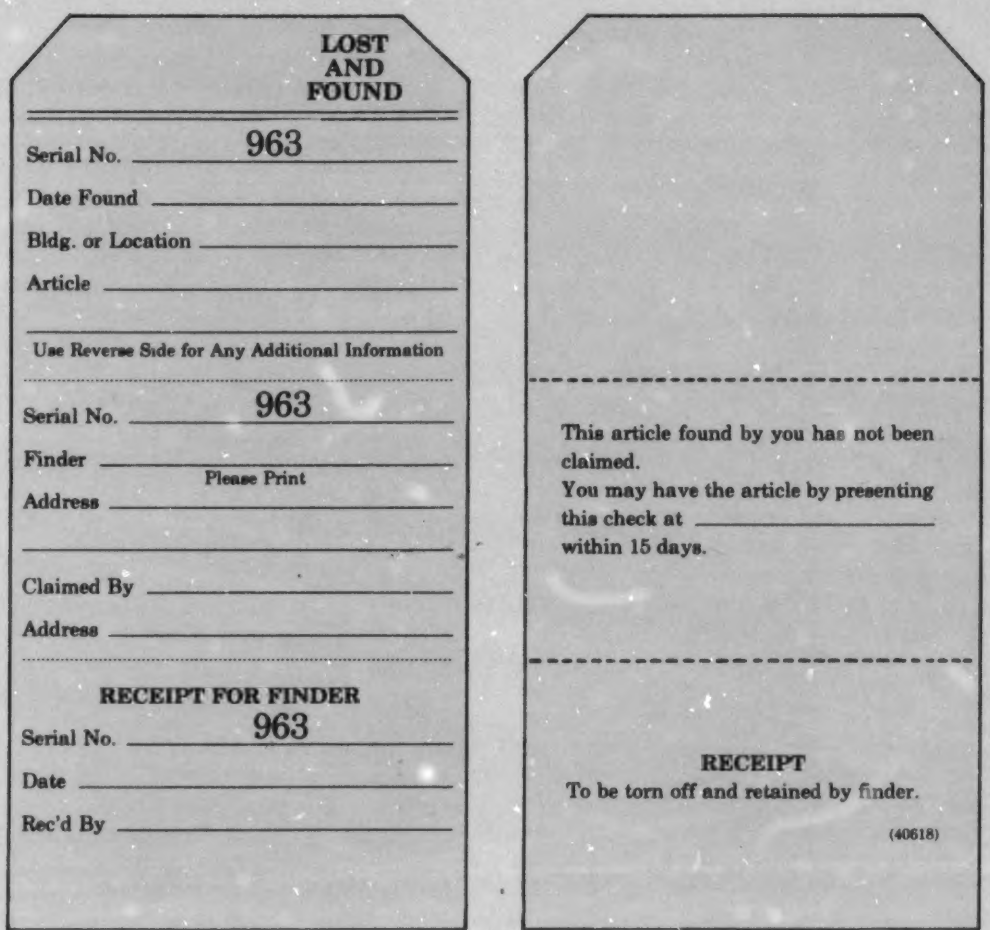


Figure 7-3—Lost and found tags.

8/Area Cleaning Programs

The typical school maintenance team must establish programs for cleaning and maintaining the following areas:

- the cafeteria
- classrooms
- corridors
- entrances
- gymnasium
- laboratories
- library, music or band rooms
- locker and shower rooms
- offices
- rest rooms
- shops
- stairways
- swimming pools

This chapter presents suggested programs for daily and periodic cleaning in each of these 13 areas. Thus, it can be used both as a reference for individual custodians and as a guide for work planners and supervisors.

Note that there are two ways to approach work schedules for these various areas. One approach is to combine all tasks that must be repeated daily with a number of tasks that must be repeated less frequently (such as weekly or monthly). Thus, a number of periodic tasks get done each day along with all routine daily tasks.

The second approach is to schedule periodic tasks completely separate from daily tasks, so that all light fixture cleaning is done one week, all carpet care the next week, and so forth.

Combining periodic tasks with daily cleaning is probably the more common approach, but experimentation should show which approach is more efficient.

Area cleaning programs will represent a compromise between the desired level of maintenance and the work force available. Few schools have the resources to maintain an ideal level of cleanliness and maintenance. Thus, available resources must be used most efficiently.

Managers can begin with daily and weekly work schedules based on the area cleaning programs described here. These schedules should be used experimentally for a week or more, with workers asked to recommend modifications. In many cases, schedules or procedures must be modified to meet individual circumstances.

Keep in mind that special circumstances, such as a long period of heavy ice and snow, may force a reduction in regular cleaning procedures so that custodians can deal with the emergency. Smaller emergencies can be expected to arise frequently, and schedules must be flexible enough to accommodate these.

For the custodian using this chapter as a reference, the first step is to look up the cleaning program for the desired area. The program described here lists all of the tasks and procedures normally associated with each area. Some of the tasks may not be applicable in a particular school; other tasks may need to be added. In any case, it is essential for the custodian to know all of the tasks required.

The second step is to find the specific procedures and services necessary to complete the tasks in each area. The numbers in parentheses after each task refer to the appropriate sections in Chapter 9/ Procedures and Services, where more detailed steps for carrying out various tasks are explained. Turn to Chapter 9, find the numbered section, and note the procedures described and the equipment and supplies needed for each job. Also note any safety or other precautions cited.

The custodian can then assemble the materials needed for all of the tasks involved in the daily or periodic cleaning program. The custodian also should note any modifications to the cleaning program that would make it more suitable for local circumstances.

Here are the 13 area cleaning programs:

CAFETERIA CLEANING PROGRAM

In some areas, standards for cafeteria cleanliness may be set by local or county regulations. Be sure to be aware of any such regulations.

Time Guidelines for Typical Cafeteria

Policing and pick-up after meal: 1/2 to 1 hour
Thorough daily cleaning: 2 to 3 hours

Daily Cleaning

(Numbers in parentheses refer to procedures sections in Chapter 9.)

After each serving of food:

1) Clear and clean tables and other equipment and furniture.
2) Place movable equipment and furniture to one side of room or remove to another area.
3) For carpeted floors: vacuum (5-2); clean (5-3) as needed.
4) For uncarpeted floors: sweep (6-2).
5) Replace equipment and furniture.
6) Remove trash (16-1).

After final serving of food for the day:

1) Bring appropriate scrubbing equipment and supplies to room.
2) Clear and clean tables, chairs and other equipment and furniture.
3) Place movable equipment out of the way.
4) Dust (4) or wash (15) flat surfaces and about one-fifth of the vertical surfaces in the room.
5) While dusting, close and lock windows and adjust window blinds to a uniform height.
6) Empty all trash containers (16-1).
7) Clean carpeting as appropriate: vacuum (5-2) and periodic procedures (5-3).
8) Clean uncarpeted floor using appropriate methods: sweeping (6-2), damp or wet mopping (6-4), machine scrubbing (6-6), buffing or refinishing (6-7).
9) Remove cleaning equipment, then look over for neatness and cleanliness.
10) Check lights and replace burned-out bulbs (8) or check to see if enough bulbs have burned out for mass replacement.
11) Report any repairs needed. (See Figure 8-1.)
12) Turn off lights and lock door if so instructed.

Periodic Jobs

It is recommended that some time be set aside in each daily or weekly schedule for a portion of the following work:

1) Periodic carpet care (5-3): one to three times per week.
2) Floor refinishing (6-7): as needed.
3) Wall washing and painting (15): schedule so all walls are washed once in three years and repainted once in five years.
4) Light fixture washing (9): as needed.
5) Washing exterior windows (18): twice a year.

Location 5

REPAIR NEEDED

Building MAIN | Room No. 302 | Date 10 Oct. '80

Work as follows:

Window pane broken—
needs replacement

Reported by JH

Figure 8-1—The custodian should report any repairs needed. Here is a sample form to make reporting easy. A full-size version is available in the Management Tools Appendix.

CLASSROOM CLEANING PROGRAM

Time Guideline

Fifteen to twenty minutes per typical school classroom for regular daily cleaning.

Daily Cleaning

(Numbers in parentheses refer to procedures sections in Chapter 9.)

1) Usually classrooms are not locked; however, those containing valuable equipment may be. Make a mental note of whether door was locked and leave it as found.
2) Turn on lights if necessary, and move custodial cart into room, near chalkboard.
3) Wash chalkboard, clean erasers and tray, replenish chalk supply (2).
4) Dust all flat surfaces and about one-fifth of vertical surfaces (4). Establish a routine of dusting certain vertical surfaces each day, so that all are cleaned regularly.
5) While dusting, close and lock windows and adjust blinds to a uniform height.
6) While dusting, empty all waste containers, including wastebaskets and pencil sharpeners (16-1).
7) Move cart back into hallway.
8) Vacuum carpeting (5-2); or
9) Dust mop floor (6-3). If chairs are movable, move out of the way as you mop, then line chairs up neatly. If room is large enough, move all chairs out of the way, dust mop the entire area, then replace

chairs. If floor covering is tile, use lines to line up chairs evenly. If seats are fixed, edge mop to the furthest corner from the door, then mop the floor halfway into the seating aisle. Bring dust out to the main aisle, working from back of room to front. Mop front of room, then move back along opposite side of room.

10) Pause at doorway and look over area for neatness and cleanliness, using the following checklist:

- All lights burning?
- Windows closed and locked?
- Chairs in orderly rows?
- Blackboards washed?
- Supply of chalk and erasers adequate?

11) Listen for unusual noises, such as hissing gas or noisy motors. Report any problem to supervisor.

12) Turn off all lights.

13) Close and lock door, if found locked.

14) Either shake mop in hallway or edge hallway to next room and pick up dirt following cleaning of that room.

15) Make or report needed repairs.

16) Replace burned out lights (8).

Periodic Jobs

1) Periodic carpet care procedures (5-3): one to three times a week.

2) Floor refinishing (6-7): as needed.

3) Wall washing and painting (15): all walls should be washed once in three years, repainted once in five years.

4) Light fixture washing (9): as needed.

5) Washing of exterior windows (18): as needed.

CORRIDOR CLEANING PROGRAM

Time Guideline

Five to ten minutes per 1,000 square feet of typical school corridor.

Daily Cleaning

1) Dust hallway, including flat surfaces, tops of display cases and chair rails (4).

2) Clean some interior glass (door glass, display glass, etc.) so that all is cleaned once a month (7).

3) Edge hallway with dust mop while moving from room to room.

4) Dust mop entire floor (6-3) or vacuum carpeting (5-2).

5) Shake out dust mop and pick up dirt (6-3).

6) If needed, damp mop spots on hallway floor. In bad weather, whole corridor may need to be damp or wet mopped (6-4).

7) Check for burned-out lights and replace (8).

8) Report repairs needed.

Periodic Jobs

1) Carpet care (5-3): one to three times a week.

2) Floor refinishing (6-7): as needed.

3) Wall washing and painting (15): walls should be washed once in three years and repainted once in five years.

4) Light fixture washing (9): as needed.

5) Washing of exterior windows (18): as needed.

ENTRANCE CLEANING PROGRAM

Time Guideline

Five to ten minutes.

Daily Cleaning

1) Sweep outside entrance ramp and steps down to main sidewalk.

2) Pick up dirt, trash, and leaves.

3) Clean both sides of door glass (7).

4) Lock or unlock doors at appointed times.

5) Replace burned-out entrance lights (8).

6) Dust mop (6-3) or wet mop (6-4) floor as needed.

7) Vacuum (5-2) entrance mats as needed.

8) Report repairs needed.

Periodic Jobs

1) Carpet care (5-3): one to three times per week.

2) Floor refinishing (6-7): as needed.

3) Wall washing and repainting (15): every three to five years as needed.

4) Light fixture washing (9): as needed.

5) Snow and ice removal (12): as needed.

GYMNASIUM CLEANING PROGRAM

Time Guideline

Thirty to sixty minutes per typical gymnasium, including seating area.

Daily Cleaning

1) Unlock door, turn on lights if necessary and move custodial cart into area.

2) If there are chalkboards, clean them (2).

3) Dust all flat surfaces and about one-fifth of the vertical surfaces (4).

4) While dusting, check, close and lock windows and adjust blinds to uniform height.

5) While dusting, check waste containers and collect and remove trash (16-1).

6) Place movable equipment or furniture to one side or in another area.

7) Dust mop seating area. Collect soil at one or more points for pickup, depending on size of area (6-3).

NOTE: Not all types of floor can or should be dust mopped. For carpeted floors, see Procedure 5-1 in Chapter 9. For floors covered with PVC vinyl, urethane, or other chemical composition, follow procedures recommended by the manufacturer.

8) Dust mop rest of floor. *Be sure dust mop controllant is compatible with wood finish. Check manufacturer's directions.*

9) Remove soil (6-3).

10) Replace furniture and equipment.

11) Check for burned-out light bulbs and replace as needed, or check to see whether enough are burned out for mass replacement (8).

12) Remove cleaning equipment and pause to check area for neatness. Listen for unusual sounds, such as hissing gas or noisy motors.

13) Report any repairs needed. (See Figure 8-1.)

14) Turn off lights before leaving area and lock door if so instructed.

Periodic Jobs

1) Floor refinishing (6-8): as needed.

2) Wall washing and repainting (15): walls should be washed every three years, repainted every five years.

3) Mass light bulb replacement (8): as needed.

4) Light fixture washing (9): as needed.

5) Washing of exterior windows (18): twice a year.

LABORATORY CLEANING PROGRAM

Be especially careful when working around chemicals and laboratory apparatus. If in doubt, do not clean or disturb the area. NEVER attempt to clean up spilled chemicals without checking with person in charge of area. (See Procedure 3 in Chapter 9.)

Time Guideline

Fifteen to twenty minutes per typical school laboratory.

Daily Cleaning

1) Unlock door. In most cases, laboratory doors are kept locked. If door is found unlocked, make a mental note to consult supervisor.

2) Turn on lights. Look over the area for problems such as chemical spills.

3) Move custodial cart into room if possible. If not, take a collector can into the room.

4) Wash chalkboard (2): however, if there is any doubt about whether material on board should be erased, leave it. Clean chalk trays and erasers, replenish chalk supply.

5) Dust flat areas that are accessible and do periodic dusting scheduled for the day (4). DO NOT dust areas cluttered with chemicals or apparatus.

6) While dusting, empty wastebaskets and pencil sharpeners. Be especially careful when emptying wastebaskets, because trash may include chemicals (16-1).

7) Close and lock windows and adjust blinds to uniform height.

8) Check paper towel dispensers and replenish supply if necessary (13).

9) Return custodial cart or collector can to hallway.

10) Dust mop entire floor (6-3).

11) Look over area for neatness and cleanliness.

12) Check to see that all lights are burning. Replace bulbs if needed (8).

13) Listen for unusual noises: hiss of steam or air or noisy machinery.

14) Turn off lights, close and lock door.

15) Shake dust mop in the hallway and pick up dirt or edge hall to next room.

16) Report repairs needed.

Periodic Jobs

1) Floor refinishing (6-7): as needed.

2) Wall washing and painting (15): walls should be washed every three years and painted every five years.

3) Light fixture washing (9): as needed.

4) Washing of exterior windows (18): twice a year.

LIBRARY, BAND OR MUSIC ROOMS

Time Guidelines

Daily cleaning for each special use area: 20 to 40 minutes.

Daily Cleaning

1) Special use areas usually are locked because they contain valuable equipment. (Leave the door as you found it, locked or unlocked.)

2) Turn on lights if necessary and move custodial cart into the room.

3) If there is a chalkboard, move custodial cart near the chalkboard and wash it. Also clean erasers and tray. Replenish chalk supply (2).

4) Dust all flat surfaces and about one-fifth of the vertical surfaces (4).

5) Check with occupant on dusting detail, because some occupants will dust the specialized equipment and perhaps the entire area. If not, establish a routine of dusting certain vertical surfaces each day so that all surfaces to be dusted are cleaned regularly.

6) While dusting, close and lock exterior windows, adjust blinds to a uniform height and check waste containers to see if they need emptying.

7) Empty all waste containers, including waste baskets and pencil sharpeners (16-1).

8) Move cart back into the hallway.

9) Dust mop floor (6-3) and/or vacuum carpet (5-2).

10) Pause at the doorway and review the area for neatness and cleanliness. Use the following checklist:

- All lights burning.
- Windows closed and locked.
- Window blinds at uniform height.
- If appropriate, chairs or other similar furniture in orderly rows.
- Chalkboards washed.
- Adequate supply of chalk and erasers.

11) Listen for unusual noises, such as hissing gas or noisy motors and report any problem to your supervisor.

12) Turn off lights.

13) Close and lock door, if found locked.

14) If the floor area was dust mopped, either shake the mop in the hallway or edge hallway to the next room and pick up the accumulated soil when it fits into the sequence of daily cleaning.

15) Make report on needed repairs. (See Figure 8-1.)

16) Replace burned out lights on a schedule provided by supervisor (8).

Periodic Cleaning

1) Carpet care (5-1): daily if possible, but at least one to three times a week depending on use of area.

2) Floor refinishing (6-7): as needed.

3) Wall washing and painting (15): all painted walls should be washed once every three years, repainted once every five years or on a schedule that meets the need.

4) Light fixture washing (9): as needed.

5) Washing of exterior windows (18): as needed.

LOCKER AND SHOWER ROOM CLEANING PROGRAM

Time Guideline

Fifteen to thirty minutes per typical locker room or shower room.

Daily Cleaning

1) Unlock door, if locked. Turn on lights and move custodial cart and cleaning supplies into room, as close as possible to work area.

2) Dust all flat surfaces and do about one-fifth of the vertical surfaces and other periodic dusting (4).

3) While dusting, close and lock windows.

4) Check waste containers and remove trash (16-1).

5) Check supplies of soap, towels, toilet tissue (13).

6) If necessary sweep floor (6-2) or pick up debris.

7) Check lights and remove burned out bulbs (8).

8) Remove graffiti and spot clean walls and partitions as needed (14).

9) Clean fixtures (11) in following order: mirror, soap dispenser (13), wash basin, towel cabinets, shower walls and shower heads, locker room benches, lockers (outside), urinals, stools, sanitary cans.

10) Remove movable furniture or equipment.

11) Either wet mop (6-4) or machine scrub (6-6) floor.

12) Replace movable equipment or furniture.

13) Report any repairs needed.

14) Remove cleaning equipment and look over area for cleanliness. Listen for any unusual sounds from equipment or drains.

15) Turn off lights and lock door if so instructed.

Periodic Jobs

1) Floor refinishing (6-7): as needed.

2) Wall washing and painting (15): walls should be washed every three years, repainted every five years.

3) Washing of exterior windows (18): twice a year.

4) Light fixture cleaning (9): as needed.

OFFICE CLEANING PROGRAM

Time Guideline

Six to twelve minutes per typical office.

Daily Cleaning

1) Unlock door and make a mental note if door was unlocked. Most office doors are kept locked. Turn on lights.

2) Move custodial cart or collector can into room. Keep collector can as close to work area as possible to eliminate steps and doubling back.

3) Clean chalkboard if needed (2). Check chalk and eraser supply.

4) Dust all flat surfaces and do about one-fifth of periodic dusting (4). A typical schedule for periodic

dusting might be: Monday. chair rounds; Tuesday, baseboards: Wednesday, sides of file cabinets; Thursday, other vertical surfaces; Friday, overhead dusting.

5) While dusting, empty all waste containers, including wastebaskets, ash trays and pencil sharpeners (16-1).

7) Take cart or collector can out of room.

8) Dust mop floor (6-3).

9) While dust mopping, replace chairs.

10) If floor is carpeted, use upright vacuum to clean traffic lanes three times a week and remove trash from unvacuumed areas. Once or twice a week, thoroughly vacuum all accessible floor areas, moving only chairs and other light furniture (5-2).

11) Look over room for neatness.

12) Check for burned out bulbs and replace (8).

13) Shake dirt from dust mop in hallway and pick up dirt or edge hallway to the next room to be cleaned.

14) Turn off lights and lock door, if found locked.

15) Report repairs needed.

Periodic Jobs

1) Carpet care (5-1): as needed.

2) Floor refinishing (6-7): as needed.

3) Wall washing and painting (15): all walls should be washed every three years and painted every five years.

4) Light fixture washing (9): as needed.

5) Washing of exterior windows (18): twice a year.

REST ROOM CLEANING PROGRAM

Time Guideline

Multiply number of fixtures by three minutes.

Daily Cleaning

1) If rest room is for persons of opposite sex, knock on door and call out "custodian" before entering.

2) Move custodial cart inside door if possible.

3) Dust all flat surfaces and do about one-fifth of periodic dusting (4).

4) While dusting, empty waste containers (16-1).

5) Note need for supplies such as toilet tissue, towels and soap. Replenish supplies as needed (13).

6) Sweep (6-2) or dust mop floor (6-3). Sweep soil into hall and pick up.

7) Remove graffiti and spot clean walls and partitions as needed (14).

8) Clean plumbing fixtures in following order:

- mirror (11)
- soap dispenser (13)
- wash basin (11)
- towel cabinets (13)
- urinals (11)
- stools (11)
- sanitary can (11)

9) Wet mop floor (6-4). Pick up water, leaving floor as dry as possible.

10) Replace burned out light bulbs (8).

Periodic Jobs

1) Floor refinishing (6-7): as needed.

2) Wall washing and painting (15): walls should be washed at least once every three years and painted once every five years.

3) Washing exterior windows (18): as needed.

4) Thorough cleaning of room: annual.

5) Light fixture cleaning (9): as needed.

SHOP CLEANING PROGRAM

Time Guideline

Thirty to forty-five minutes for typical school shop area.

Daily Cleaning

1) Unlock door, turn on lights, move cart into room if possible. If not, move waste container into room as close to work area as possible.

2) Dust open areas (4).

3) Empty trash as you dust (16-1). Test weight of containers before lifting as they may contain heavy wood or metal shavings.

4) Close and lock windows, adjust blinds to uniform height.

5) Sweep (6-2) or dust mop (6-3) area. Pick up soil in hallway.

6) Look over room for neatness.

7) Check to see that all lights are burning. Replace burned out bulbs as necessary (8).

8) Listen for unusual noises. Check to see that all machines have been turned off.

9) Turn off lights, close and lock door if found locked.

10) If soil was not picked up, edge hallway to next room to be cleaned.

11) Report repairs needed.

Peroidic Jobs

1) Floor refinishing (6-7): as needed.

2) Wall washing and repainting (15): all walls should be washed every three years and painted every five years.

3) Light fixture washing (9): as needed.

4) Washing of exterior windows (18): twice a year.

STAIRWAY CLEANING PROGRAM

Time Guideline

Five to eight minutes for each section or flight of stairs.

Daily Cleaning

1) Dust one side of stairway up to next floor. Dust other side on way down (4).

2) While dusting, check stairs for foreign objects.

3) Take dust mop to stair landing on floor above and dust mop stairs going down (6-3).

4) Be careful when backing down stairs to be aware of last step. Do not knock debris onto floor below when mopping open stairways.

5) Shake mop in lower hallway and pick up dirt or edge hallway to next room, then shake mop.

6) Check hall area for burned-out light bulbs and replace (8).

7) Report repairs needed.

SWIMMING POOL MAINTENANCE GUIDE

Swimming pool maintenance is covered in the State of Illinois by "Minimum Sanitary Requirements for the Design and Operation of Swimming Pools and Bathing Beaches" (Circular 4.102), dated 1976. It is available from the Illinois Department of Public Health, Office of Environmental Health, Division of Engineering. Page 73, Article XVIII, covers Operation and Maintenance.

Supplies and Equipment Needed

Rubber boots
Goggles or face shields
Rubber gloves
Plastic buckets
Scrub brushes with handles
Nylon push brooms
Scrub pads and holder
Automatic scrubber
Pressure sprayer
Appropriate-sized stepladder
"Closed—Maintenance" signs
Mop handles
Cotton mopheads
Gear press mop units
Automatic pool cleaner
Hand skimmers

DAILY SWIMMING POOL REPORT

DATE _____ REPORTED BY _____

LOCATION

RECIRCULATION

TIME	STOP	START	TOTAL HOURS	WATER ADDED	PRESS. DIFF.
AM					
PM					

STERILIZATION

TIME	ARRIVE	LEAVE	AVERAGE RATE	Cl₂ WEIGHT	CHEMICALS ADDED
AM					
PM					

TIME	STOP	START	TOTAL HOURS	VACUUM MIN. USED	FILTERS WASHED
AM					
PM					

TEMPERATURE				RESIDUAL CHLORINE					
WATER		AIR		pH	Alk	SHALLOW		DEEP	
AM	PM	AM	PM			AM	PM	AM	PM

REMARKS _____

Figure 8-2—A typical Daily Swimming Pool Report form.

General Procedure

Mechanical equipment for swimming pool maintenance and operations should be maintained according to the manufacturer's instructions and approved codes, such as the National Electrical Code and all state and local codes, such as Circular 4.102 in Illinois.

Figure 8-2 shows a daily swimming pool report that is typical. Periodic reports also are usually required on forms specified by most state departments of public health.

Swimming pools differ in design and operation. The following guidelines should be modified and a maintenance procedure developed for each pool.

Cleaning of pools may be divided into daily and periodic tasks.

Time Guideline

Sixty to 90 minutes for a typical pool.

Daily Cleaning

1) Remove equipment necessary for daily cleaning. If area is dry, sweep and pick up debris and place in trash container.
2) Check overflow systems and automatic surface skimmers. Clean if necessary.
3) Remove floating debris from water.
4) Remove debris from bottom of pool.
5) Clean drain gutter if needed.
6) Wash deck area, using hose approved for hot water, spray nozzle or a power sprayer machine, and an approved all-purpose cleaner.
7) Remove cleaning solution from deck area.

Periodic Cleaning

1) As needed (but as least once a year) drain pool and inspect. Frequency is based on use of pool.
2) Perform needed maintenance, such as repair of cracks and chips and repair and replacement of mechanical equipment.
3) Follow manufacturer's instructions to check the following:
   - pump
   - filters
   - disinfectant feeders
   - flow indicators
   - gauges
4) Clean drain gutter if needed.
5) Clean walls of pool.
6) Clean bottom of pool.

Safety Precautions

Electrical outlets and water spigots should be safe and usable. All equipment used in daily and periodic cleaning should be carefully inspected for safe operation.

9/Custodial Procedures and Services

Here are detailed instructions for performing common job procedures efficiently and effectively. Experience undoubtedly will dictate modifications to adapt the instructions and the time guidelines to local situations. Procedures are numbered so they can be easily located by custodians and supervisors who are using the Area Cleaning Programs in Chapter 8. The job procedures and services described here are as follows:

1 Ashtrays and Smoking Urns
2 Chalkboards
3 Chemical or Acid Spills
4 Dusting
5-1 Floors—Carpeted
5-2 Vacuum Cleaning
5-3 Periodic Carpet Care
6-1 Floors—Uncarpeted
6-2 Sweeping
6-3 Dry (Dust) Mopping
6-4 Wet Mopping
6-5 Power Scrubbing
6-6 Floor Machine Procedures
6-7 Sealing and Refinishing Floors
6-8 Refinishing Wood Gymnasium Floors
7 Glass (Interior)
8 Light Bulb Replacement
9 Light Fixture Cleaning
10 Moving
11 Plumbing Fixture Cleaning
12 Snow and Ice Removal
13 Soap and Paper Dispensers
14 Spot Washing (Graffiti)
15 Wall Washing
16-1 Waste Removal
16-2 Waste Removal—Large Containers
17 Waxing Furniture
18 Window Washing

1 ASHRAYS AND SMOKING URNS

Job Description and Frequency

Ashtrays and smoking urns should be emptied and cleaned daily.

Precautions

- Be sure there are no hot embers before emptying ashtrays or smoking urns.
- Be sure glass is not splintered or cracked.

Time Guideline

- 1/4 to 1 minute per unit.

Equipment

- Cheesecloth or cloth pads.
- Spray glass cleaner.
- Collector can.

Procedure

- Be sure there are no live embers, then dump contents into collector can.
- Wipe clean with a damp pad or cheesecloth.
- On stubborn buildup, spray with glass cleaner and wipe clean with a pad of cheesecloth.

2 CHALKBOARDS

Job Description and Frequency

Chalkboards in offices, classrooms and other locations should be washed to remove accumulated dust, unless marked "Do Not Erase" or with similar directions.

Precautions

- Consider using rubber gloves, as chalk dust can dry and chap hands.
- Be sure the chalkboard surface is designed to be washed with water. Some painted surfaces may be damaged by water.
- Be careful not to splatter papers, furniture, equipment with water.

Time Guideline

- Three to ten minutes per 50 square feet of board.

Equipment

- Two plastic pails
- Four sponges
- Chalk and erasers
- Rubber gloves

Procedure

- Put on rubber gloves (optional but recommended).
- Each pail should be half-full of water. Dip two sponges into one pail and squeeze out excess water so that sponges are wet enough to pick up chalk dust but not wet enough to drip.
- Hold sponges side by side in lower right-hand corner of the chalkboard, and wash the board by pushing the two sponges along the surface in the following pattern:

Step A: Move from lower right-hand corner to upper right-hand corner. Turn sponges 90 degrees and wash upper edge of board. Turn sponges 90 degrees and move from upper left-hand corner to lower left-hand corner, as shown in Figure 9-1(a).

Step B: Turn sponges 180 degrees and wash a vertical strip, overlapping the vertical strip just washed. Turn sponges 90 degrees and wash a second horizontal strip, overlapping horizontal strip previously washed, as shown in Figure 9-1(b).

Step C: Turn sponges 180 degrees and wash the rest of the board in horizontal strips, each time overlapping the previously washed strip, as shown in Figure 9-1(c).

By making the turns as indicated, the leading edge of the sponge remains the same. *Sponges should not be lifted from the board* until about half of the board has been washed. Then they should be turned over, again keeping the leading edge the same.

- After all boards have been washed, lay sponges on chalk tray and run them along the tray, discarding pieces of chalk less than one inch long.
- Run the felt side of erasers over the sponges and replace erasers on cleaned tray.
- Put sponges into wash bucket. Squeeze out the two clean sponges in the second bucket. Squeeze rinse sponges drier than wash sponges.
- Rinse boards, following the pattern in Steps A, B and C above.
- Put sponges back in rinse bucket.
- Replenish chalk and erasers as needed. Generally, provide one piece of chalk and one eraser for every four feet of board.
- In the course of the job, replace rinse and wash water as needed.

Figure 9-1(a)—In cleaning chalkboard, begin at lower right-hand corner and move sponges to upper right hand corner. Turn sponges 90 degrees to keep the same leading edge and move across the top of the board to the upper left hand corner. Again turn sponges 90 degrees to keep the same leading edge and move down to the lower left hand corner.

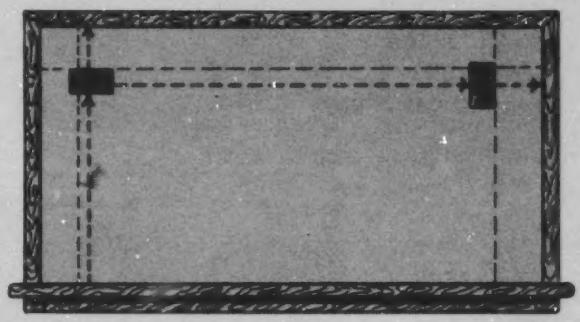


Figure 9-1(b)—Turn sponges 180 degrees without lifting them from the board and return to the top of the board, overlapping the area just cleaned. Turn the sponges 90 degrees to the right and return back across the board, again overlapping the clean area.

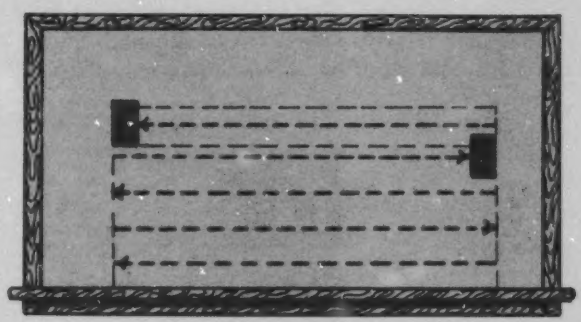


Figure 9-1(c)—Turn sponges 180 degrees and return back across the board, overlapping cleaned area. Continue to turn sponges and move back across the board until the entire board has been cleaned.

Storage

At the end of each shift, empty buckets. Rinse buckets and sponges. Refill buckets about half full of water. Leave sponges in buckets. Store on the custodial cart in the locked custodial storage room.

3 CHEMICAL OR ACID SPILLS

Job Description

Cleaning up chemical or acid spills *should be done only under proper technical supervision.*

Safety Precautions

- A chemical or acid spill can be cleaned up *only after the chemical has been neutralized.* It is the responsibility of the individual who uses the laboratory or other area in question to properly neutralize the spill.
- Do not clean any spill if there is reason to suspect it might be acid or some other dangerous chemical. *Call supervisor immediately.*
- Leave the area until the spill has been identified.

Time Guideline

Varies widely. Fifteen to 30 minutes may be used as a beginning estimate.

Equipment

- Wet-dry vacuum
- Wet mops
- Mop buckets
- Mop wringer

Procedure

- After chemical has been neutralized, decide whether to use a vacuum (5-2) or wet mop (6-4), depending on size of spill.
- Use procedures outlined for the equipment used.
- Supervisor will make a decision as to whether refinishing of the floor area is necessary after a chemical spill.

4 DUSTING

Job Description and Frequency

Removal of dust from equipment and furniture. Proper dusting removes dust, rather than moving it from one location to another. Flat surfaces should be dusted daily. Vertical surfaces may be dusted weekly. Dusting should be scheduled so that the entire area is dusted once a week.

Precautions

- Be careful not to brush dust or dirt into eyes.
- Take care not to knock items off desks, tables, bookcases or window ledges.
- Do not leave a treated duster on a desk or table for any length of time, as it may damage the surface.

Figure 9-2—In dusting a desk, items can be moved, but should not be removed.

Time Guideline

- Varies widely depending on how clear the area to be dusted is. In general: 10 percent or less of area obstructed—5 minutes per 1,000 square feet; 50 percent or more of area obstructed—15 minutes per 1,000 square feet.

Equipment

- Duster handle.
- Short-strand cotton duster.

Procedure

- All desks, tables and similar flat surfaces should be dusted, but normally objects are not removed for dusting. It is the responsibility of the occupant to clear surfaces if they are to be dusted. See Figure 9-2.
- Tie treated duster mitt onto the frame. Lay duster flat on surface. Move duster entire length of surface. Be careful to avoid striking any objects. Overlap dusted area with each successive pass as in Figure 9-3.

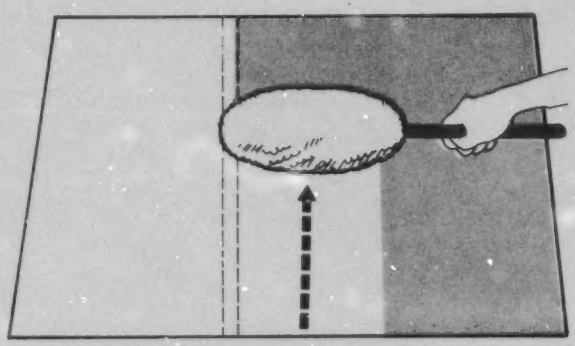


Figure 9-3—In dusting, overlap the clean area to avoid missing any of the flat surfaces.

Figure 9-4—Vertical surfaces, such as chair rails and legs, should be dusted at least once a week.

• Dust telephone, areas between tables or desks, chairs and file cabinets. See Figure 9-4.

• Laboratory tables and window ledges and other similar areas should be dusted only when there is no equipment there.

• At times, two dusters can be used at the same time, one in each hand, to dust baseboards, chair rails, and grill work on stairs. Care must be taken when two dusters are used at once to avoid hitting objects.

• Dust right to left if right-handed and top to bottom, so dust and litter are brushed onto floor, to be picked up with dust mop.

• If duster is properly treated, one pass over each area is sufficient. When duster becomes too dirty to pick up dust, it should be replaced and returned for laundering and re-treatment.

Care and Storage

• Some duster mitts require no initial treatment as they come from a laundry already treated and packed in a plastic bag. *Supplies should not be over-stocked* as the treated duster mitts will dry out if stored too long.

• If not already treated, the duster should be treated with a small amount of dust controllant. After treatment, duster should be allowed to "rest" for several days before using. If used at once, duster could leave oil streaks and mark painted surfaces.

• Dusters being used may be stored on the custodial cart. Clean duster mitts should be stored on a shelf in a locked custodial storage room. Dirty dusters should be placed in a receptacle in the custodial room. Worn out or torn dusters should be reported or returned to the supervisor for replacement.

5-1 FLOORS—CARPETED

Selection

The decision to use carpeting as a floor covering normally is based on acoustical values rather than maintenance factors. Carpeting should be used to trap soil in such areas as entrances or elevators, to enhance prestigious offices, and to reduce custodial costs. When annual man-hours to provide floor care exceeds 60 per 1,000 square feet, carpeting should be considered.

When the decision to carpet is made, it is important to make the right selection. It usually does not pay to install domestic type carpeting on school floors.

Color is another important factor: either a light-colored or dark-colored carpet will tend to show soil more readily and require more custodial time to maintain an acceptable appearance. Under most school conditions, a medium colored carpet with light and dark patterns will maintain a better appearance and require less maintenance time.

Carpet density is another factor to consider. A carpet made with a loose construction allows soil to penetrate and abrade the fibers. A commercial-type carpet is made with the face fiber slightly packed so most of the soil will remain on top where it can be easily removed.

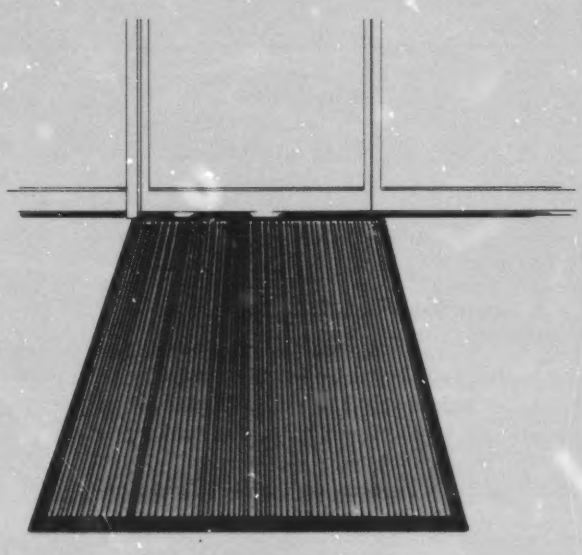


Figure 9-5—Carpet entrance mat catches dirt before it can be tracked further into the building.

Figure 9-6—Anti-static spray is available in several forms.

The type of carpet fiber is important. The basic choice is between a natural fiber (such as wool) or a man-made fiber (such as nylon). It is important to know the fiber so that all cleaning materials are compatible.

Installation also is important: improper installation can cause poor appearance as well as excessive maintenance costs. The glue-down method should be reviewed for school installations, using the adhesive recommended by the manufacturer. The carpet installer should be held responsible for poor installation.

Preventive Maintenance

- Keep as much soil as possible off the carpeting by judicious use of entrance matts (see Figure 9-5).
- Increase the frequency of carpet care in heavy traffic areas or around food serving areas, such as vending machines.
- Properly-used anti-static treatments can reduce static electricity (see Figure 9-6).
- Consider the use of a dry compound cleaner which is sprinkled onto traffic lanes to restore the appearance of carpeting.

Carpet Cleaning Procedures

Vacuuming—Unless foot traffic is nil, carpeted areas should be vacuumed daily. Some areas may require vacuum cleaning more than once a day (such as areas near an entrance). An upright vacuum machine is considered best for removing soil from carpeting. (See Procedure 5-2.)

Stain and spot removal—The longer a spill or spot remains on the carpet fibers, the harder it will be to remove. The carpet maintenance program must provide for prompt spot and spill removal. In removing stains, spots and spills, it is important to work carefully so that a larger spot is not caused by the cleaning process. Follow the manufacturer's directions for the product used. (See Figure 9-7.)

Periodic cleaning—A number of methods for cleaning soiled carpets are available: dry cleaning, dry foam, dry powder, detergent solutions, and water or steam extraction. (See Procedure 5-3). As with vacuuming, frequency varies with the exposure to traffic and other soiling conditions. The cleaning method selected should be based on the carpeting material and the manufacturer's recommendations.

Carpet Repair and Replacement

Delayed carpet repairs lead to early replacement. Promptly repair seams, rips, etc. to prolong the life of the carpet. Calculate the approximate replacement time and plan for it.

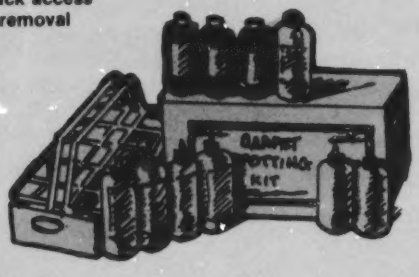
5-2 VACUUM CLEANING

Also see Procedure 5-1.

Job Description

Regular vacuuming of carpet prolongs life by removing sharp gritty particles that can grind rug fibers.

Figure 9-7—The custodian should have quick access to a kit of spot removal products.



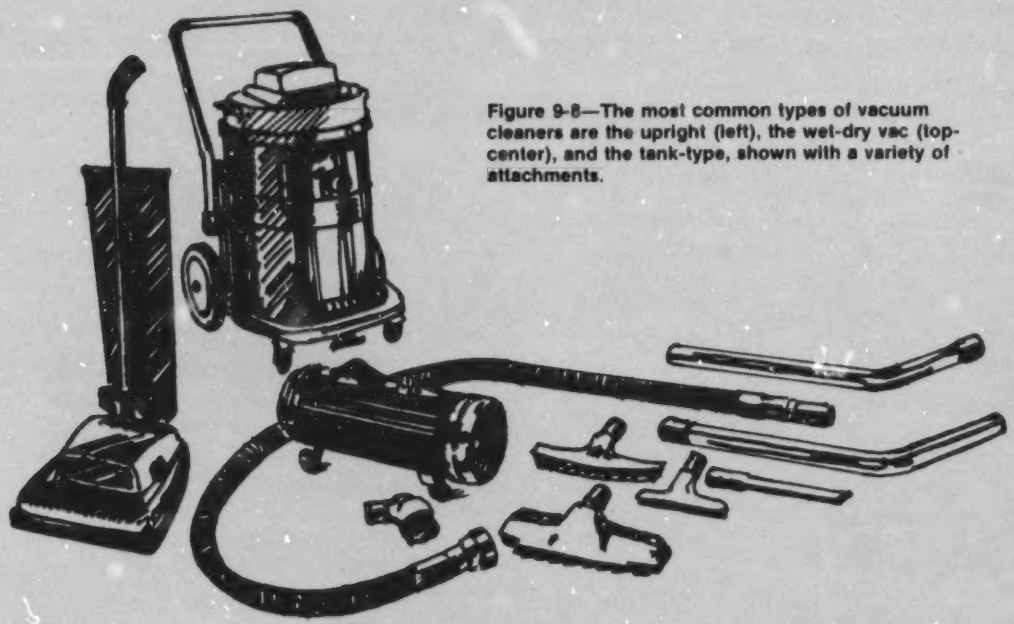


Figure 9-8—The most common types of vacuum cleaners are the upright (left), the wet-dry vac (top-center), and the tank-type, shown with a variety of attachments.

Precautions

- Be careful not to bang machine against walls, furniture or equipment.
- Never leave machine unattended in public areas.
- Never over-extend your reach in the back-and-forth movement.
- Be careful of electrical outlets in flooded areas.

Time Guideline

Suggested time for 1,000 Square Feet	Dry Vacuum	Wet Vacuum
Unobstructed area:	20 minutes	30 minutes
Moderately obstructed area:	30 minutes	40 minutes
Heavily obstructed area:	40 minutes	50 minutes

Equipment

Three types of vacuum machines are available (see Figure 9-8). The choice depends upon the particular job.

- Wet-dry machines are used to remove liquids.
- Upright and brush-type vacuum cleaners are used on carpets to agitate the pile and remove the soil by air movement.
- Tank-type dry vacuum cleaners are used for dusting or carpet cleaning.

Procedure

- One slow movement over the area is better than several fast, short back-and-forth movements. When the flow of air is stopped or obstructed, cleaning action stops.
- Dust room to be vacuumed and empty waste cans before beginning to vacuum carpet.
- Move wastebasket and chairs out of the way (do not place on desks and tables).
- Unwind cord and plug into 110-volt outlet. Starting at doorway turn on vacuum, adjust height of brush and move vacuum forward at arms length. (See Figure 9-9.)

Figure 9-9—Push the vacuum to arm's length. Then return it, overlapping the first pass.

Figure 9-10—To pick up water with a wet-dry vacuum, place the wand in the water and pull it toward you.

- Push the vacuum across the carpet and, overlapping the first pass, return it. Continue this movement until the entire carpet area has been cleaned. Usually one pass over each strip is sufficient.
- After the entire area has been vacuumed, turn off machine, raise brush and unplug and rewind cord.
- Return chairs and wastebaskets to correct position in room.
- In heavily used areas, the walkways may need to be vacuumed a second time. In most areas, daily vacuuming is sufficient.
- Attachments should be used periodically to vacuum hard-to-reach places, such as along baseboards and desks.

Tank-type vacuum—This machine may have a retractable cord. It has a flexible hose and wand. Use in same manner as upright machine. Various attachments are used for edging baseboards and furniture and to dust.

Wet-dry vacuum—This machine is normally used as a wet vacuum. If it is used as a dry vacuum, the dust filter must be put into the vacuum tank. Machine is then used in same way as an upright or tank-type.

If machine is to be used to pick up water, remove flexible hose, wand and electric cord from tank. Latch motor unit to tank, assemble flexible hose and wand, and plug cord into 110-volt outlet. Turn switch to ON position.

Place wand into water, slightly tipped forward and slowly pull wand toward you. (See Figure 9-10.) Repeat this movement until water has been picked up or until machine shuts off, which indicates the tank is full of water. If this is the case, remove vacuum motor top from tank to a service sink. If possible, get help to dump the water. Some models pump water from the tank.

Storage

Always empty and clean machine before storing (see Figure 9-11). Electric cord, flexible hose and attachments should be kept with the machine in an orderly manner. Entire unit is then stored in a locked custodial storage room.

5-3 PERIODIC CARPET CARE

Also see Procedure 5-1.

Job Description

In addition to daily or regular vacuuming (see Procedure 5-2), periodic dry cleaning or shampooing of carpets is necessary to prolong carpet life. After cleaning, carpets may be treated with an anti-static material to reduce static electricity.

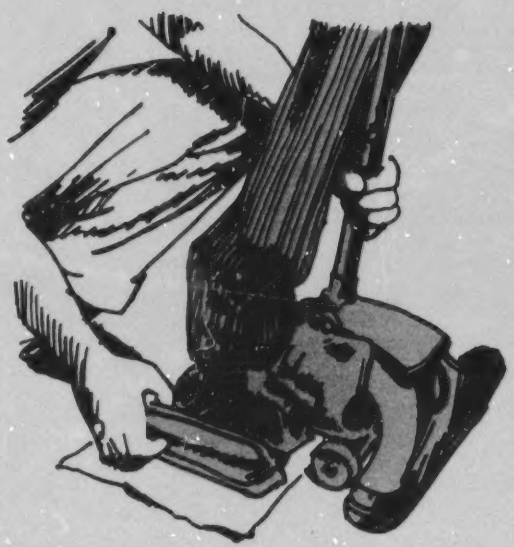


Figure 9-11—Clean out the vacuum before storing it.

Figure 9-12—Use a floor machine (right) or rotary brush machine (left) to work dry cleaning compound into the carpet pile.

Precautions

- Use all equipment according to manufacturer's recommendation.
- Use extra caution when using electrical cords on wet surfaces.
- Most carpet cleaning procedures can damage carpets if improperly used. If there is any question about whether a product is compatible with carpeting, test in an out-of-the-way corner.

Time Guideline

- Varies widely. Managers should develop time standards.

Equipment

- Varies, depending on procedure.

Dry Cleaning Procedures

- Sprinkle organic dry cleaning compound onto carpet and work into the pile, using a rotary brush machine. (See Figure 9-12.)
- Allow compound to absorb soil according to product directions.
- Remove compound and soil with vacuum cleaner.

Dry Foam Procedures

- Depending on humidity conditions, allow one to two hours before area can be open to traffic.
- Using a dry foam machine, spray foam onto surface of carpet and work into surface. (See Figure 9-13.)
- Allow foam to absorb soil, according to manufacturer's instructions.
- Remove foam and soil with vacuum cleaner.

Detergent Solution Procedures

- Allow time for carpet to dry thoroughly before use.

Figure 9-13—Mist sprayer deposits dry foam on carpet surface, where it is worked into the pile by a rotating brush.

Figure 9-14—For detergent cleaning, a floor machine with a liquid dispenser feeds detergent through the rotating brush.

Figure 9-15—A water/steam extraction machine cleans in one step.

- A floor machine is used to feed detergent solution through a rotating brush onto the carpet. (See Figure 9-14.)
- Remove cleaning solution and soil with wet pickup vacuum. It is important to pick up suspended soil promptly before it can resettle into the carpet.
- Water/steam extraction machine drives cleaning solution into carpet pile under pressure, then extracts solution and soil in one step. (See Figure 9-15.) Follow manufacturer's instructions.

Storage

All carpet cleaning equipment should be thoroughly clean and dry before being stored in secure storage room.

6-1 FLOORS—UNCARPETED

Floor maintenance includes thorough cleaning and, when necessary, stripping, sealing, refinishing and buffing. These procedures may be assigned to the custodian in charge of cleaning the particular area or to a two-member custodial crew. Procedures are performed as needed, depending on type of floor, its condition and use of the area. The following information is intended to help custodial workers and supervisors develop their own school guidelines. The chart on page 51 lists procedures to be used on various types of floors—wood, resilient, and hard—in good, fair, poor and extreme conditions. The numbers in parentheses refer to detailed instructions on performing the procedures found in Section 6-1 through 6-7.

The chart does not include floors made of PVC vinyl, urethane, or other similar chemical compounds. These floors are relatively new to the public schools in the 1980s and come in a growing variety of compositions. The maintenance team should develop procedures for treating such floors in accordance with each manufacturer's recommendations.

For more detailed definitions of floor materials, see "Floor Types and Covering Materials" in the custodial glossary, Chapter 11.

Time Guideline

Will vary widely according to procedures used, condition of floor, obstructions and other factors. Develop local guidelines using times given for specific job procedures, modified through experience. A balance should be reached between appearance of the floor and time spent on work.

General Procedures

- Observe condition of finish and floor covering. Unless specific instructions have been received, decide on cleaning and finishing methods to be used.
- Have proper supplies and equipment on hand before beginning work.
- Water should be used very sparingly on sealed

PROCEDURES FOR PERIODIC CARE OF UNCARPETED FLOORS*
(numbers in parentheses refer to more detailed explanations in Sections 6-2 through 6-8)

Condition of Finish and/or Covering	Wood Floors	Resilient Floors (vinyl, rubber, asphalt, cork, tartan)	Hard Floors (concrete, terrazzo, marble, slate, quarry, tile)
GOOD Light soil No void areas where finish has worn away	Dust mop (6-3) Clean with finish (6-6)	Dust mop (6-3) Clean with finish (6-6)	Dust mop (6-3) Wet mop (6-4)
FAIR Moderate soil Few void areas	Dust mop (6-3) Dry clean or use appropriate compound with floor machine (6-6) As needed: finish (6-8)	Dust mop (6-3) Wet mop (6-4) or scrub with floor machine (6-6), depending on soil As needed: finish (6-7)	Dust mop (6-3) Wet mop (6-4) or scrub with floor machine (6-6), depending on soil As needed: finish (6-7)
POOR Heavy soil Numerous void areas	Dust mop (6-3) Renovate (6-6) As needed: finish and/or seal (6-8)	Dust mop (6-3) **Scrub with floor machine (6-6) or power scrubber (6-5) As needed: seal and/or finish (6-7)	Dust mop (6-3) **Scrub with floor machine (6-6) or power scrubber (6-5) Seal (6-7)
EXTREMELY POOR Heavy soil Numerous void areas Surface appears porous or buildup of finish is evident	Dust mop (6-3) Renovate (6-6) Seal (6-8) As needed: finish (6-8)	Dust mop (6-3) **Scrub with floor machine (6-6) or power scrubber (6-5) As needed: seal and/or finish (6-7)	Dust mop (6-3) **Scrub with floor machine (6-6) or power scrubber (6-5) Seal (6-7) As needed: finish (6-7)

*This table does not include floors made of PVC vinyl, urethane, or similar chemical compounds. Because of variations among such products, it is essential to base maintenance procedures on each manufacturer's recommendations.

**For heavy soil, a power scrubber may be used in large, open areas. A floor machine is used in small or obstructed areas.

wood floors and never on unsealed wood floors.

- Resilient floors should not be exposed to large amounts of water for extended periods.
- All work should be recorded on the Floor Maintenance Daily Work Report Card (see the Management Tools Appendix). Any work requiring extra time also should be noted on the daily card.

6-2 SWEEPING

Also see Procedure 6-1.

Job Description

Push brooms are used to remove dry bulky soil which is not easily removed by dust mopping. Floors also should be swept before dusting or wet mopping.

Time Guidelines

Unobstructed area: 10 minutes per 1,000 square feet

Moderately obstructed area: 15 minutes per 1,000 square feet.

Heavily obstructed area: 20 minutes per 1,000 square feet.

Precautions

- Be careful to avoid striking people or objects with broom handle.
- Check wooden handles for splinters before using.

Equipment

- Push broom of appropriate width
- Counter brush or toy broom

Figure 9-16—In sweeping, cover as much area as possible with each stroke, but do not stretch arms.

- Dust pan, dust pan with long handle
- Putty knife

Procedure

- Use putty knife to loosen gum or other sticky substances.
- Size up the area and select a starting point.
- Grasp broom handle with left hand about half way down the handle. Right hand should be near the end of the handle. (If left-handed, use opposite positions.) See Figure 9-16.
- Keep feet about 12 inches apart and start with brush near feet.
- Push soil away a reasonable distance, four to five feet. Cover as much area as possible with each stroke, but do not stretch arms.
- Push broom with top hand and allow handle to pass through other hand.
- Shift weight from foot to foot as you push brush forward and return it.
- It may be helpful to tap the brush at the end of the stroke so soil drops out of fibers.
- Develop a natural pattern and rhythm to sweeping.
- Use a toy broom or counter brush to clean hard-to-reach areas.
- Move soil into a pile and use brush to push into dust pan.

Storage

- Clean out bristles with brush comb after work and hang broom or brush so bristles hang free. See Figure 9-17.
- If the handle is movable, change its position once a month to prolong life of broom.

6-3 DRY (DUST) MOPPING

Also see Procedure 6-1.

Job Description

Dry mopping, or dust mopping, is a quick way to clean floors and, done properly, is effective. Often a cotton strand mop treated with a dust controllant is used; it effectively removes dry soil and dust from most types of floors, but a treated mop should not be used to clean wet foors.

Precautions

- When moving backward while mopping, be aware of possible hazards in your path.
- When mopping stairs, always feel for the next step with your foot before shifting weight.
- Keeping arms close to the body helps eliminate fatigue. See Figure 9-18.
- Never leave a mop standing or spread on a floor unattended for any length of time.
- Be alert at all times, especially in congested areas such as laboratories or on stairways.
- Always be aware of the position of the mop handle to avoid hitting furniture, equipment, walls or windows.

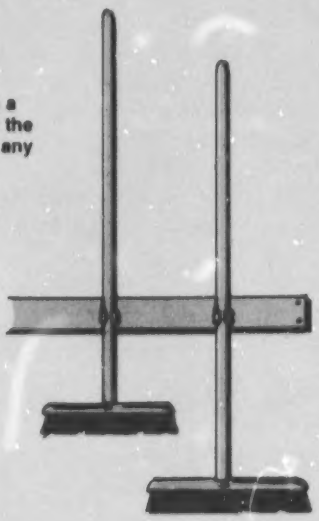


Figure 9-17—Hang a broom or brush so the bristles are free of any weight.

Figure 9-18—In dust mopping, keep your arms close to your body to reduce fatigue. Keep the leading edge of the mop the same as you move around the room.

Time Guidelines

Unobstructed area: 7 minutes per 1,000 square feet

Moderately obstructed area: 10 minutes per 1,000 square feet

Heavily obstructed area: 20 minutes per 1,000 square feet

Equipment

- Dust mop
- Wedge dust mop

Procedures

- Dust mops may be used to remove litter, soil and dust from most kinds of floors.
- Use mop *after* dusting furniture and equipment so that dust brushed to the floor will be removed.
- Pattern of mopping will vary, depending on the area. Generally, the movement is in a clockwise or counter-clockwise pattern, pushing the dirt to the main aisle for pickup. See Figure 9-19.
- Mop closely around legs of equipment, base-

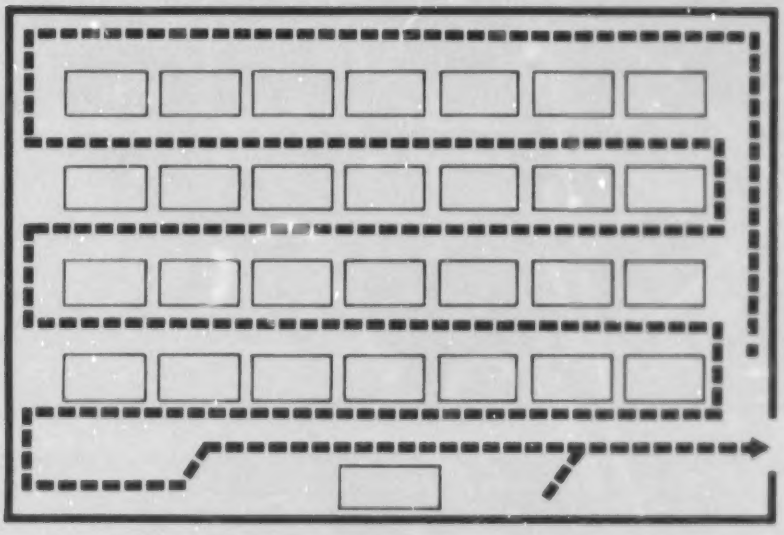


Figure 9-19—Dry mopping pattern must be adapted to room and equipment layout. Pattern illustrated here is suitable for most traditional classrooms.

Figure 9-20—Dust mopping under a desk or table (see text).

boards, corners, and behind open doors. Avoid doubling back, which wastes time.

- Lay mop head flat on the floor and make sure the leading edge of the mop stays the same as you move around the room. Move right to left if right-handed or left to right if left-handed.
- When mopping under a desk or table, hold the mop handle close to your right side, and mop head close to your feet. Move chair away from desk with your left hand. See Figure 9-20. Bending slightly at the waist, mop under the desk from right to left, returning mop to starting position. Replace chair under desk.
- When approaching corners, with a twist of the wrist, let one end of the mop move into the corner, and proceed at a 90 degree angle along the baseboard.
- In open areas, such as large rooms or hallways, push the mop ahead with top end of mop handle held about chest high.
- To mop steps, back down the center of the stairs, mopping the third step above you. Start at the middle and cover both halves of the step by twisting the wrist. Feel for the next step down with right food before putting weight on this foot. Be sure to locate the last step before shifting weight. Also see suggestions in Figures 9-21 and 9-22.
- Do not raise the mop off the floor until it is full of dust and soil. Then, in an open, unmopped area, raise the mop from the floor about 12 inches, hold one hand one-third of the length from the mophead, and the other hand two-thirds of the length from the mophead, and shake dust and soil from the mop. Keep mophead low to avoid scattering dust into the air.
- Use the mop to move soil into a small pile that can be picked up with a dust pan and counter brush. Always pick up the dirt after shaking the mop. Remop the area after dirt is picked up. Never shake the mop outside the building onto the ground.

Storage and Treatment of Mophead

- Initial treatment: Use about eight ounces of dust controllant to treat a new wing mophead. Apply controllant on dusting side of head to center

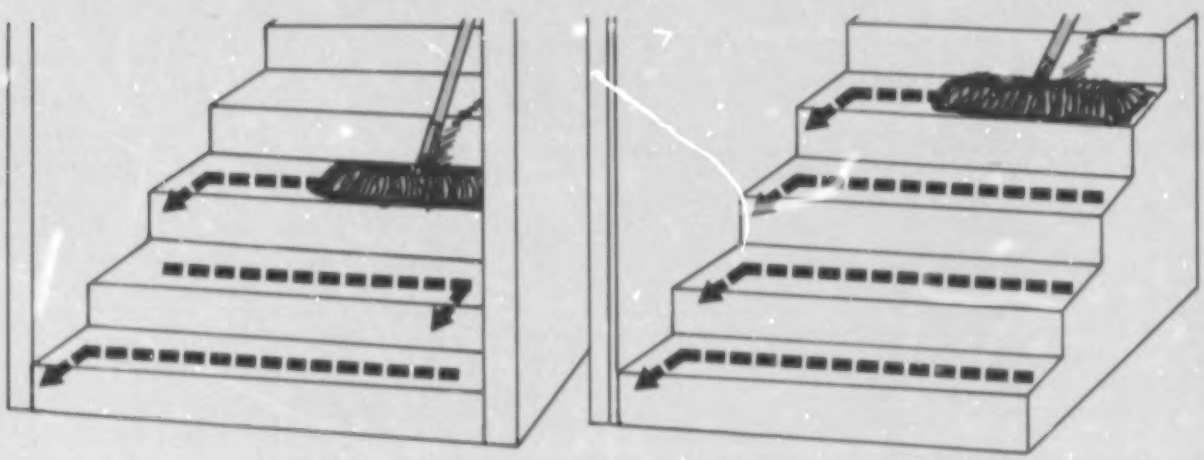


Figure 9-21—For best results on enclosed stairs (left) dry mop in alternate directions. On partially open stairs (right) mop only in one direction—toward the enclosed side.

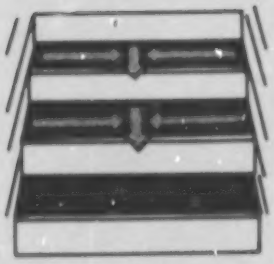


Figure 9-22—On stairs that are open on both sides, mop toward the center of the stairs and then down.

of strands. Fold mophead over onto itself, then allow it to set for about one week.

- Retreatment: Periodic retreatment of the mophead should be done in the same way as the original treatment, except that only four ounces of controllant should be used. Retreat the mophead at the end of the workshift and preferably on the last workday of the week, to allow time for the treatment to penetrate.
- To store the mophead, shake the mop as described under "Procedures" and store (in a metal mop pan) in a locked custodial storage room. Lay the head flat on the bottom of the pan.

6-4 WET MOPPING

Also see Procedure 6-1.

Job Description

Wet mopping is used to loosen and remove soil from floors in areas that cannot be adequately cleaned with the dry mop, such as restroom floors, entrances, around vending machines, cafeterias, and so forth.

Precautions

- Be careful when walking on a wet floor.
- Control traffic in the area while the floor is wet.
- Be careful in raising the mop handle when wringing mophead.

Time Guidelines

Unobstructed area: 30 minutes per 1,000 square feet

Moderately obstructed area: 40 minutes per 1,000 square feet

Heavily obstructed area: 55 minutes per 1,000 square feet

Equipment

- All-purpose cleaner (APC)
- Mop handle
- Cotton mophead
- Gear press mop unit

Procedure

- Mix all-purpose cleaner and water in solution according to manufacturer's directions.
- Sweep or dust mop the area to remove debris.
- **For hard-surface floors,** dip mophead in bucket and squeeze excess solution from mop with wringer. Leave mop wet enough to wet floor thoroughly.
- Fan mop and edge floor along baseboard to far end of room. When fanning mop, be careful not to splatter walls, baseboards, or fixtures. Wipe up any splatters immediately with cheesecloth or similar clean cloth. See Figure 9-23.

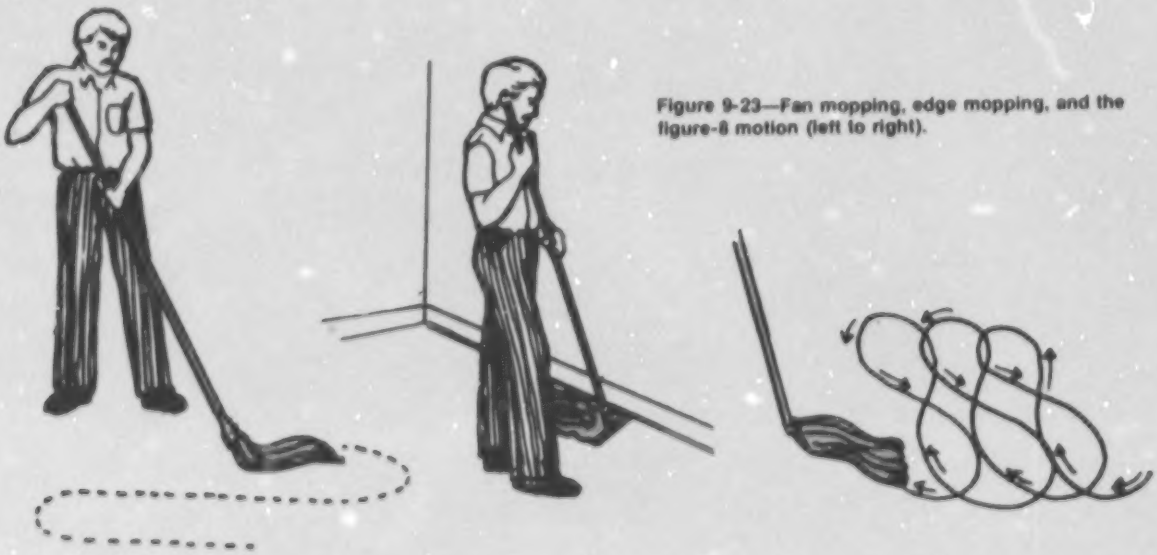


Figure 9-23—Fan mopping, edge mopping, and the figure-8 motion (left to right).

• Using a figure-8 motion, cover entire area with solution. If necessary, re-wet mop in bucket.

• After entire area is covered, dip mophead in solution. Put mophead in wringer, holding mop handle with left hand and wringer handle with right hand, stand slightly to the left of center of the bucket and flex knees to put weight onto wringer handle. Keep back straight at all times.

• Change cleaning solution as soon as it becomes dirty to prevent a streaky floor. Turn mophead periodically.

• Cover floor again as above, using figure-8 pattern, and leave floor as dry as possible.

• **For soft-surface floors (tile or linoleum),** use only drying, or second step of the procedure, to control the amount of water on the floor. *Excess water can damage a soft surface.*

To Carry Water

• Carrying a bucket of water should be avoided, if at all possible. However, sometimes it will be necessary to carry a bucket up a stairway. In this case, the bucket should contain only about three gallons of water.

• Put mophead in the bucket. Bring wringer handle down and put it under the bail of the bucket with the mop handle between the bail and the wringer.

• Grasp wringer handle with right hand and bend knees, keeping back straight and right arm fully extended.

• Raise bucket and bring legs back to straight position.

• Be careful to place foot down firmly on stairs before shifting body weight. Use handrails for balance.

Storage

• Rinse mophead thoroughly and spread it out on mop rack or over bucket to allow it to dry. See Figure 9-24.

• Thoroughly rinse and dry mop bucket and wringer. Periodically, apply a few drops of oil to castors.

• Entire unit should be stored in locked custodial storage room.

6-5 POWER SCRUBBING

Also see Procedure 6-1.

Job Description

Scrubbing and cleaning a large open area using a power scrubber. (See figure 10-28 in Chapter 10.)

Safety Precautions

• Do not smoke in battery-charging area. To do so could cause an explosion.

• Charge battery in a well-ventilated area.

• Be sure battery terminals are connected correctly.

• Connect charger before turning it on.

• Be aware of location of electrical outlets and take precautions to avoid them when area is wet.

• Be careful not to run scrubber into walls or furniture which could cause damage.

• When removing tanks from scrubber, observe correct lifting techniques, keeping back straight and knees slightly bent to reduce strain on back.

Time Guidelines

Unobstructed area: 15 minutes per 1,000 square feet

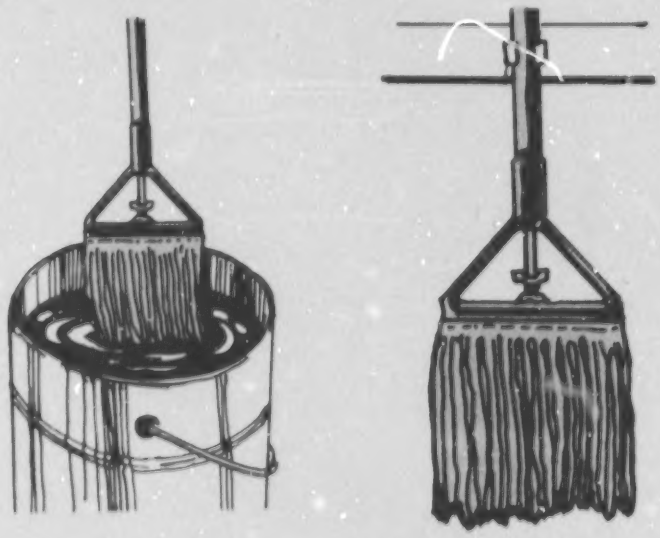


Figure 9-24—Thoroughly rinse the wet mop and hang it in a well-ventilated storage room.

Average obstructed area: 30 minutes per 1,000 square feet.

Setup and cleanup time make it uneconomical to do less than one to two hours of automatic power scrubbing at a time.

Equipment

- Battery-powered, self-propelled power scrubber with portable battery charger.

Procedure

- Take machine and proper cleaning solution tank to work area.
- Turn switch to ON position. Turn water solution control lever to ON.
- Start machine moving and, using hand pressure on clutch lever, lower scrub brushes until they make contact with the floor. At the same time, lower squeegee using the foot lever located at the center of the machine on the operator's side.
- Guide machine across the floor. Near the end of the area being cleaned, release the clutch drive lever and pivot the machine by hand.
- Clean the next strip of floor, overlapping the previously scrubbed area.
- Shut off solution about 10 feet before reaching the end of the area being cleaned.
- Raise brushes to clear floor before stopping the machine.
- Keep squeegee lowered until all solution has been picked up, then raise squeegee.

Cleaning and Storage

Before storing the automatic scrubber:

- Empty tanks and flush with water.
- Check filter and clean with water.
- Clean battery connections with a mild solution of ammonia and water or soda and water.
- Wash all exterior parts of the machine with a mild solution of all-purpose cleaner and water.
- Wipe bottom edge of squeegee with a piece of cheesecloth. Leave squeegee in UP position.
- Check and rinse hoses periodically.
- Check gearbox and chains once a month. Notify supervisor when they need lubrication.

6-6 FLOOR MACHINE PROCEDURES

Also see Procedure 6-1.

Job Description

Floor machines may be used to clean small or obstructed areas that will not permit use of a power scrubber.

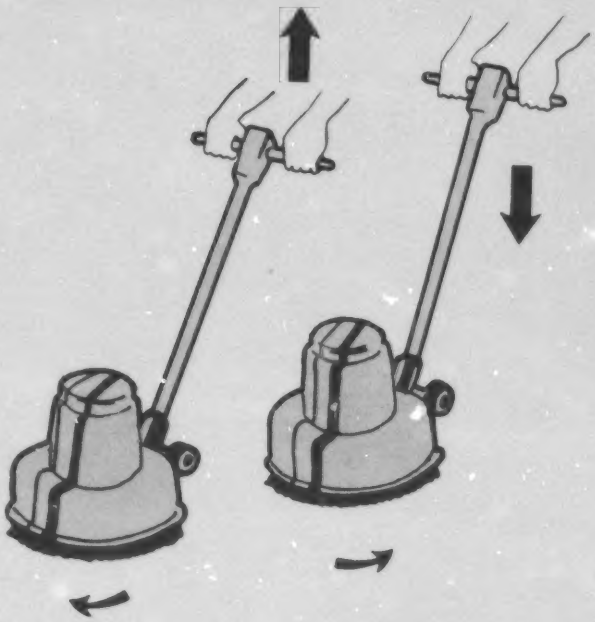


Figure 9-25—A floor machine is used for wet scrubbing. Raise handle to move machine right; lower handle to move left.

Time Guidelines

See Power Scrubbing, Procedure 6-5.

Equipment

- Either a rotary type floor machine which rotates at about 175 rpm or a high-speed machine rotating at about 1,100 rpm.
- Brushes, abrasive pads, or steel wool pads, depending upon cleaning action required and manufacturer's instructions.
- All-purpose cleaner or stripping compound.
- Wet-dry vacuum or mop and tank.

Procedure for Routine Scrub

- Use a water mop to wet down a small area in front of the floor machine with solution of all-purpose cleaner or wax stripper.
- Leave cleaning solution on floor less than a minute
- Use a putty knife to remove gum or other material, but be careful not to damage floor covering.
- Scrub with abrasive pad or scrub brush, depending on condition of floor, following manufacturer's instructions. See Figure 9-25.

- Pick up water with wet-dry vacuum or wet mop.
- Rinse floor with clear water and pick up rinse water.
- Remove water as soon as possible from soft floors. Do not let water run under furniture or file cabinets.

Other Procedures for Floor Machine

Dry cleaning: Either a fine grit abrasive pad, a buffing brush or a steel wool pad may be used with a floor machine for dry cleaning. The action of the machine loosens surface particles, which are then picked up with a dust mop.

Cleaning with finish: The procedure is basically the same as the method described for dry cleaning. Use floor finish, usually in a 1:1 dilution with water, instead of all-purpose cleaner or wax stripper. Do not rinse.

Renovating: Renovating compound is composed of a solvent cleaner and sealing material, and is used primarily on vegetable fiber floor coverings. The compound is applied with a strand mophead and worked with a floor machine using steel wool pads to pick up excess solution and soil. **Caution:** Used pads may ignite spontaneously. They should be removed from the building and placed in a safe area. They should not be disposed of until they are completely dried out.

6-7 SEALING AND REFINISHING FLOORS

Also see Procedure 6-1.

Job Description

Sealing and refinishing of floors may be performed by the custodian in charge of cleaning the area or by a two-person custodial crew. The work is performed as needed. Normally, floors are refinished for one of the following three reasons, in order of importance: to protect the surface from wear, to facilitate daily maintenance, and to enhance appearance. Such factors as durability, water resistance and ease of application are of primary importance in selecting floor products. Appearance is important, but secondary.

Time Guidelines

Unobstructed area: 60 minutes per 1,000 square feet

Moderately obstructed area: 120 minutes per 1,000 square feet

Heavily obstructed area: 180 minutes per 1,000 square feet

Equipment

Depends upon method of cleaning and refinishing selected.

Procedure

- Decide on method of cleaning and refinishing, depending on type of floor and condition of finish. For guidance, see the chart in Procedure 6-1.
- Thoroughly clean floor, using appropriate method (Procedures 6-2 through 6-6).
- Floors should be stripped of all finish *only* in isolated instances, and *only* in consultation with the supervisor. Normally floors are stripped only if there is a change in products to be used or if the floor has been improperly maintained.
- Seal floor if necessary (see below).
- Allow floor to dry and apply one coat of finish according to manufacturer's instructions. Finish may be applied with a long strand mophead or with a special tool supplied by the manufacturer.
- Use the standard figure-8 mopping pattern. Be sure to overlap strokes for even coverage. Take care to avoid streaking.
- Always spread a *thin* coat of finish.
- The first coat should not be applied closer than 12 inches from the baseboard, unless the floor has been stripped.
- Let the first coat of finish dry thoroughly. Fans may be necessary in humid weather.
- Often one coat of finish will be sufficient. If two coats are needed, apply second coat, working up to baseboards.
- Let second coat dry thoroughly.
- Clean any spattered baseboards or furniture.
- Buff only if absolutely necessary or if floor is in a show area, such as reception area or office.

General Instructions

- The most efficient work pattern will vary among different areas. Study the area to determine the most efficient pattern.
- During periods when other work cannot be done (for example, while finish is drying), clean abrasive pads and other equipment and/or prepare other areas for floor work.
- Rotate various jobs so each crew member shares in the work.

Sealing

- If seal is necessary, apply seal to clean, dry floor. (See chart in Procedure 6-1 and follow manufacturer's directions.)
- Use floor machine or mop to work seal into floor according to manufacturer's instructions.
- Let first coat of seal dry. Apply second coat if

necessary.

- If necessary, use floor machine with fiber or polish brush to buff the seal the day after it has been applied.
- Allow seal to dry thoroughly before applying finish.

6-8 REFINISHING WOOD FLOORS (GYMNASIUMS)

Also see Procedure 6-1.

Job Description

Gymnasium floors should be dust mopped at least twice on days when school activities are going on. The amount of periodic care needed depends on the amount of use for school and outside activities.

Choosing a Seal and Finish

Hillyard, Inc., of St. Joseph, Missouri, recommends the following:

- When selecting a wood seal and finish, choose compatible products manufactured by the same company. Most companies sell compatible products as a team.
- There are several categories of products available. Originally, phenolic or tung oil materials were used, and these are still available. Next came oil-modified epoxies, then oil-modified urethane products. The newest is a water-borne epoxy. Moisture cured urethanes are not recommended because they may be toxic during application and slippery. When choosing a solvent-based product, the buyer should look for a wood seal of about 28 to 30 percent solid content (NVM), and the gymnasium finish should be about 40 percent solids.
- Be careful to purchase a high-grade solvent for the cleaning process. A low grade solvent is high in oil content and leaves an oily film on the floor, which causes seals and finishes to peel.

Procedure

- At least one two-worker crew should be used for every 5,000 square feet of floor.
- After the floor has been sanded, check for sanding marks by wiping certain areas with a towel soaked with high grade solvent. Examine areas to see whether sanding marks are visible.
- Vacuum the floor after sanding. Also vacuum sawdust from window sills, bleachers, stages and other horizontal surfaces.
- Tack rag the floor three times or more, using a towel wrung out in the high grade solvent. Use a push broom to "mop" the floor with the towel until the floor is clean.
- Apply the first coat of seal using a 12-inch lambs wool applicator, applying the seal *across* the grain in a four-foot-wide strip across the floor.
- A second worker, with a dry applicator, should follow about 10 feet behind and pull the seal out with the grain. Enough people should work on a team so that the edge is always wet.
- After the first coat of seal has been applied, allow the floor to dry overnight (at least 12 hours).
- Using #2 steel wool, thoroughly go over entire floor and again tack rag once or twice to pick up dust and steel wool particles.
- Apply the second coat of seal the same as the first, and allow to dry overnight.
- Go over the coat with #2 steel wool and tack rag the floor.
- Lay out and paint game markings in accordance with interscholastic standards.
- If paint lines dry more than 24 hours before recoating, all lines must be steel wooled again.
- Tack rag floor again and apply a coat of finish in the same way that the seal was applied. Allow to dry overnight, go over with steel wool, tack rag, and apply final coat of finish.
- Keep everyone off the floor for a minimum of three days, and preferably seven days to allow finish to cure properly.
- Dust mop floor before use.

7 GLASS, INTERIOR

Job Description

Cleaning entrance and partition glass, mirrors, glass desk tops.

Precautions

- Do not spray window cleaner toward you. Protect your eyes.
- Be sure there are no splinters on wooden doors.
- Do not over-reach to reach the tops of doors or partition glass.
- Make sure there are no cracks in mirrors and desk top glass.
- Do not stand on furniture or equipment or above the third step from the top of a stepladder.

Time Guidelines

- 1/4 to 1 minute per unit.

Equipment

- Cheesecloth or cloth pads
- Bucket
- Squeegee
- Sponge
- Spray bottle (manual)

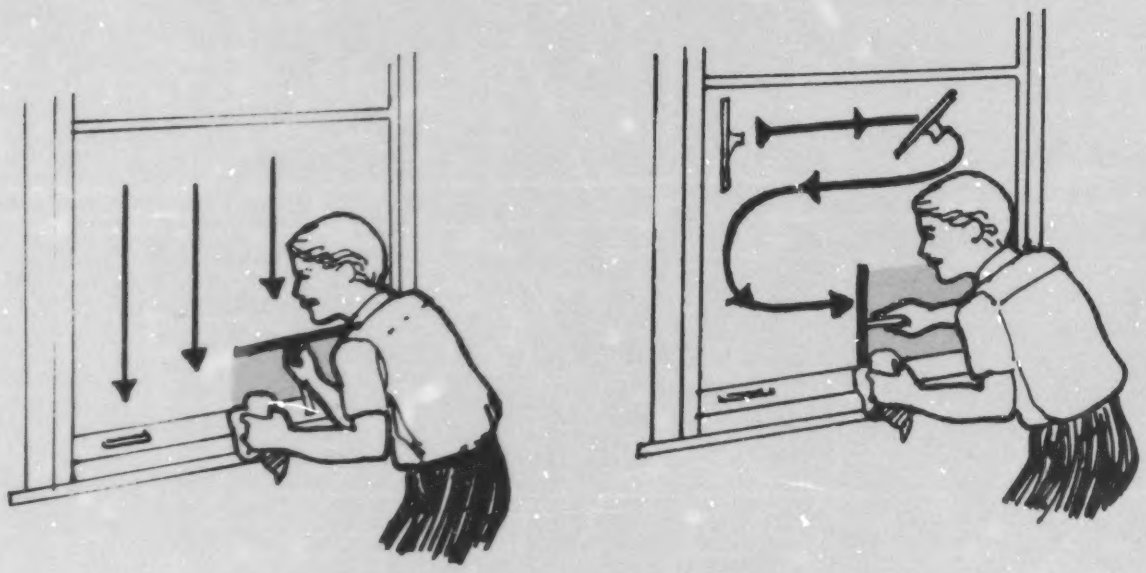


Figure 9-26—Efficient squeegee motions make water run toward trailing edge and away from the cleaned area.

Procedure

- In general, apply a small amount of cleaner to glass using a vertical spraying motion.
- Use cloth pad to spread cleaner.
- Rub glass with cloth pad or paper towel until cleaner dries.
- Avoid using too much glass cleaner; it will be hard to remove.

Door Glass and Partition Glass

- Use squeegee and water method. Wash glass with sponge and water. With either horizontal or vertical overlapping strokes, wash the entire surface.
- Use a stepladder to clean upper glass first.
- One of two squeegee motions can be used to remove water from glass. If side-to-side strokes are used, start with the squeegee in a vertical position at an upper corner of the window and stroke across the pane to the opposite side, then make a simple half turn and return. Use one continuous back-and-forth overlapping stroke, as shown in Figure 9-26.

If vertical strokes are used, start in upper corner and draw the squeegee to the bottom of the pane in separate overlapping strokes.

- After each stroke, wipe the blade of the squeegee with a sponge.
- When the job is finished, wipe up any excess water with a sponge.

Mirrors, Glass Top Desks and Spot Washing Door Glass

- Use spray bottle method: Spray glass with window cleaner, then wipe dry with a pad of cheesecloth. (See Figure 9-27.)
- On stubborn spots, a second application of window cleaner may be necessary.

Storage

- Empty and dry bucket.
- Refill spray bottle.
- Rinse and ring dry cheesecloth and sponge. Hang up cheesecloth to dry.
- Store all materials and tools in locked storage room.

8 LIGHT BULB REPLACEMENT

Job Description

Incandescent and fluorescent light bulbs or tubes normally are replaced when burned out. However, in hard to reach areas, bulbs or tubes may be replaced on a pre-determined schedule or after a certain number have burned out. Mass replacement usually is done by a crew using special ladders.

Precautions

- Be sure electricity is turned off during bulb or

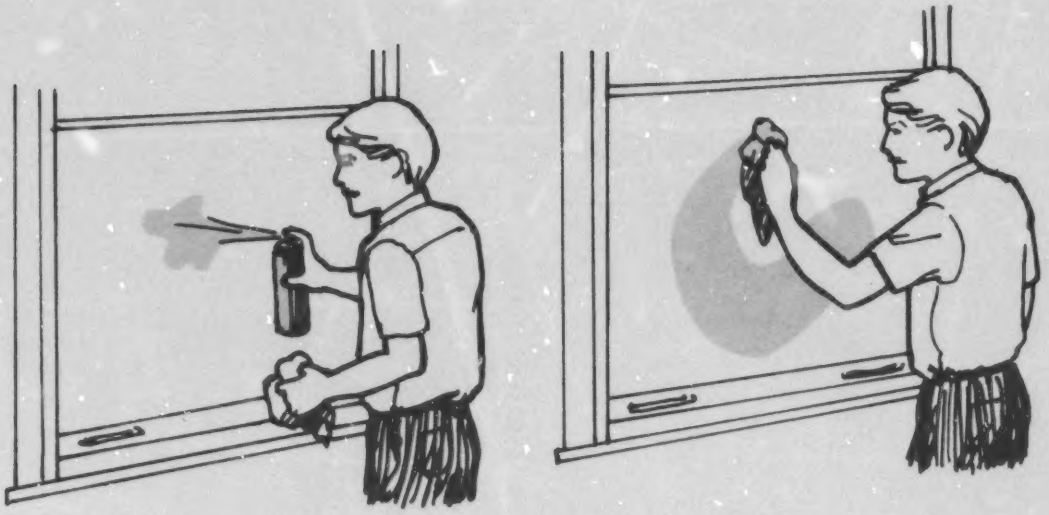


Figure 9-27—Using spray bottle method, use cheesecloth pad to wipe dry.

tube replacement work. Turn back on only after work is complete.

- Use bulbs or tubes of the same wattage as those being replaced.
- Carefully clean up any broken glass.
- Use stepladder carefully.
- If there is any question about a job, see your supervisor before beginning work.

Time Guidelines

- 1/2 to 7 minutes per bulb or tube.

Equipment

- Stepladder or scaffolding (see Figure 9-28)
- Duster
- Replacement bulbs or tubes
- Screw driver
- Special bulb replacement tool (see Figure 10-23 in Chapter 10)

Procedure

- Check to make sure the problem is just a burned out bulb and not trouble in the wiring. Check with supervisor if there is any question.
- Turn off electricity.
- Set up stepladder or scaffolding. Check for safety.
- Open light fixture or remove globe and put it in safe place. Clean before reassembling fixture.
- Never use a replacement bulb or tube with a higher wattage unless it has been approved by your supervisor.
- Replace tube or bulb and discard burned out one in appropriate trash container.
- Complete replacement record.
- Turn electricity back on; check to see that light works.
- If necessary report repairs on a "repair needed" form (see Figure 8-1 in Chapter 8).

Figure 9-28—Ladders, scaffolding and screwdriver are among the equipment used to replace light bulbs.

9 LIGHT FIXTURE CLEANING

Job Description

Regular cleaning of light fixtures maintains maximum lighting efficiency.

Precautions

- Turn off light switch before doing any cleaning.
- Clean light fixtures only when there are few people using the area.
- Never touch hot light bulbs with wet hands.
- Use ladder or scaffolding safely.
- Clean fixtures in a safe place where they will not be damaged.
- Remove movable equipment and furniture if necessary.
- Use rubber gloves to protect the hands.

Time Guidelines

- 5 to 10 minutes per light fixture.

Equipment

- Two plastic pails
- Ladder or scaffolding (see figure 9-28)
- Sponges
- Rubber gloves
- Cheesecloth or cloth pads
- All-purpose cleaner (APC)
- Treated duster
- Tank vacuum cleaner and attachments

Procedure

- Move equipment to room or area where fixtures are to be cleaned. Make certain the lights to be cleaned are turned off.
- Be careful to avoid soiling floor or ceiling.

Dry Fluorescent Light Fixture Cleaning

- Select a starting point and dust or vacuum each fixture, starting at one end and moving the duster or vacuum lengthwise. (See Figure 9-29.)

Wet Fluorescent Light Fixture Cleaning

- Fill one plastic pail with clear warm water and the other pail with warm water and APC.
- Use a separate sponge in each bucket.
- Place ladder and two buckets in safe position for working.
- Remove loose soil with treated duster or damp sponge.
- Open fixture, carefully remove fluorescent tubes, and put them in a safe place.
- Remove egg-crated type grid.
- With wash sponge, clean fixture inside and out.

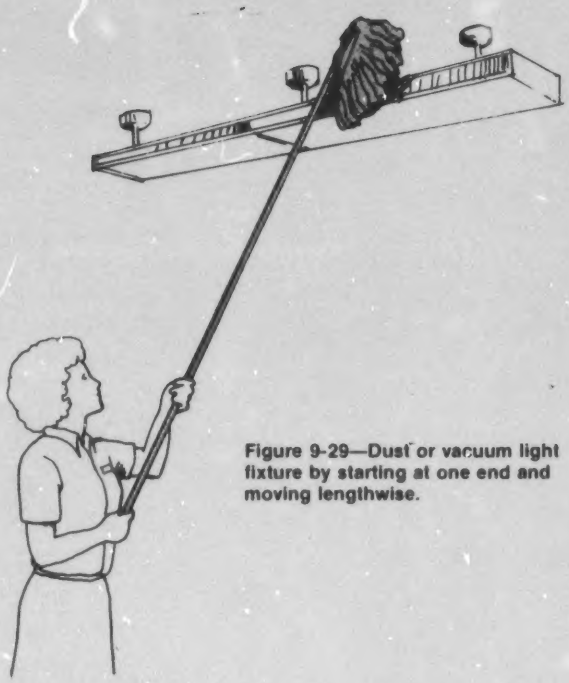


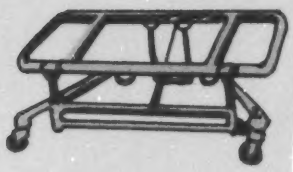
Figure 9-29—Dust or vacuum light fixture by starting at one end and moving lengthwise.

- Wipe with rinse sponge. Allow to air dry or wipe dry with clean dry cloth.
- Wipe fluorescent tubes with damp cloth and replace in fixture.
- Replace clean egg-crate grid.
- Check work. Fixture should be free of all dirt.

Dry Incandescent Light Fixture Cleaning

- Be sure light is turned off.
- Remove globe and clean inside and out with a damp cloth.
- Replace clean dry globe.

Figure 9-30—Two-wheeled truck and four-wheeled truck.



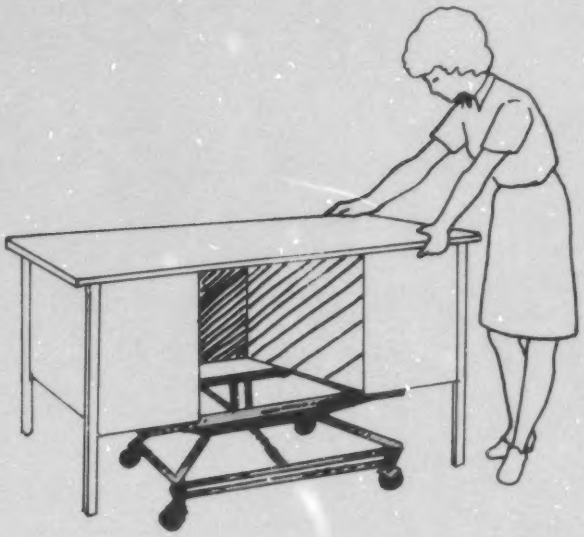


Figure 9-31—A desk dolly (left) and how it works.

Wet Incandescent Light Fixture Cleaning

- Be sure light is turned off.
- Remove globe and wash inside and out with sponge and APC solution.
- Rinse globe using clean sponge.
- Allow globe to air dry or use a clean dry cloth to wipe it dry.
- Replace clean globe on light fixture.
- Be sure to replace wash and rinse water when necessary.

10 MOVING

Job Description

School custodians often are called upon to move supplies, equipment or furniture.

Precautions

- Lift carefully, keeping back straight and knees slightly bent, to avoid back injuries.
- Be careful in maneuvering large objects to avoid damage to doors, walls or other furniture or equipment.

Time Guideline

- No estimates available; depends on situation.

Equipment

- 2-wheeled truck (see Figure 9-30)
- 4-wheeled truck
- Desk dollie (see Figure 9-31)

Procedure

- Walk from starting point and point of final destination to find the shortest and easiest route available.
- Prepare both areas and the route between by moving anything that will interfere with the move.
- Assemble moving equipment and take it to the starting point.
- Check size and weight of each load and select an appropriate piece of equipment.
- Be careful to use equipment as recommended and to use correct lifting procedures in lifting heavy furniture and equipment. (See Figure 9-32.)

Figure 9-32—Select the right piece of equipment for each moving job and use it correctly to avoid injury and property damage.

Figure 9-33—Toilet cleaning kit provides a convenient carriage for acrilan swab and all-purpose cleaner.

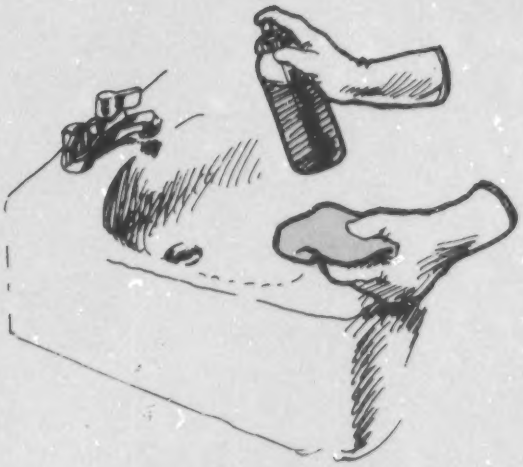
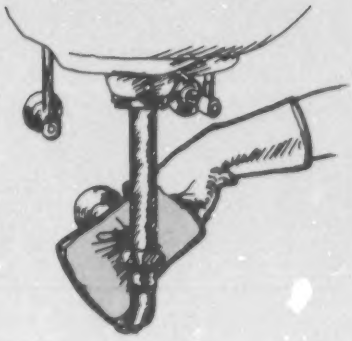


Figure 9-34—Solution of all-purpose cleaner should be used on wash basins. Scour inside, outside, underneath, and faucet.



Storage

After each use, clean equipment, inspect for damage and store in locked storage area.

11 PLUMBING FIXTURE CLEANING

Job Description

Plumbing fixtures must be cleaned inside and out daily. A pattern of cleaning restroom fixtures and water fountains should be established to eliminate doubling back and ensure that all fixtures are cleaned daily.

Precautions

- Do not use the same cheesecloth that has been used on urinals and stools to wash basins.
- Do not use abrasive cleansers for routine cleaning. For stubborn stains, use cleansers approved for vitreous china or stainless steel.
- Be sure not to spray APC solution into eyes.
- Since water and cleaner will be splattered onto floor, be careful in moving around room.
- Be aware that people may be using the room while it is being cleaned.
- If stronger than normal cleaners are needed due to water conditions or special circumstances, use as directed by manufacturer.
- Use acid cleaners with special care.

Time Guideline

- Three minutes per fixture.

Equipment

- Acrilan swab (see Figure 9-33)
- Abrasive pad
- All-purpose cleaner (APC)
- Cheesecloth or cloth pad
- Rubber gloves
- Sponge mop
- Glass cleaner

Procedure

- Clean all fixtures with a solution of about one

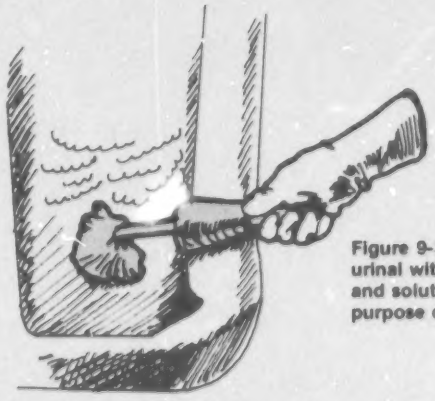


Figure 9-35—Clean urinal with acrilan swab and solution of all-purpose cleaner.

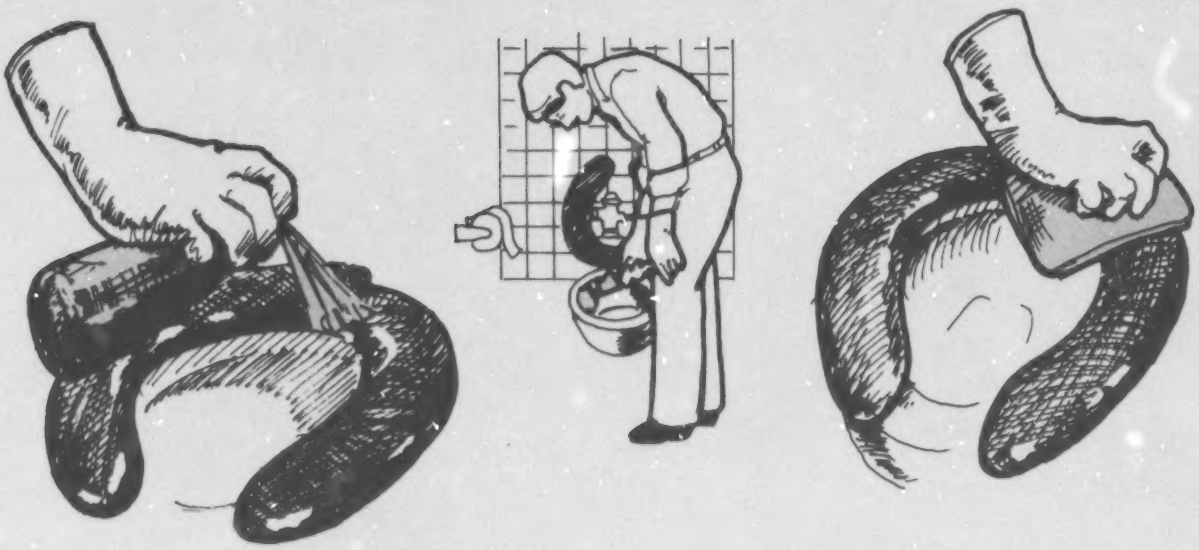


Figure 9-36—Spray the entire stool area with all-purpose cleaner, scrub with an acrilan swab, and dry the seat with a pad of cheesecloth.

ounce of APC to one quart of water. Allow solution to set for several days to ensure it is thoroughly mixed. (Or follow manufacturer's directions. Solution for cleaning fixtures should be approximately four times the strength used for mopping floors.)

Wash Basin

- Wearing rubber gloves, spray APC solution over entire basin, including faucets. With abrasive pad, scour entire basin—inside, outside and underneath. Pay particular attention to areas around drain and base of faucets. (See Figure 9-34.)
- Allow to air dry.

Urinals

- Put on rubber gloves.
- Flush urinal, then force water over trap in drain with acrilan swab.
- Spray APC solution over entire area of urinal and onto the swab.
- Scrub urinal inside and out, and down into the drain as far as possible, under rim at sides and top and underneath. (See Figure 9-35.)
- Let urinal air dry, then flush.

Stools

- Put on rubber gloves.
- Flush stool.
- Raise seat and force water over the trap with the acrilan swab.
- Spray entire stool area, including seat, with APC solution; scrub with acrilan swab. (See Figure 9-36.)
- Pay particular attention to drain, under rims, and where seat attaches to stool.
- Dry both sides of seat with pad of cheesecloth.
- Leave seat in upright position. Flush stool.
- Spray APC solution onto pad of cheesecloth and clean splatters and graffiti from partitions, using abrasive pad if necessary.

Service Sinks

- Clean service sinks with acrilan swab.
- Spray sink area and scrub inside and out with APC solution.
- Allow to air dry.

Shower Stalls

- Wear rubber gloves.
- Spray APC solution on walls and scour with abrasive pad to remove soap residue and body oils.
- Clean drain and floor area with acrilan swab or sponge mop.
- Make sure drain areas are free from hair, pieces of soap, and other debris.
- Dry walls with cheesecloth. Run water to rinse floor.

Water Fountain

- Spray APC solution over top areas of water

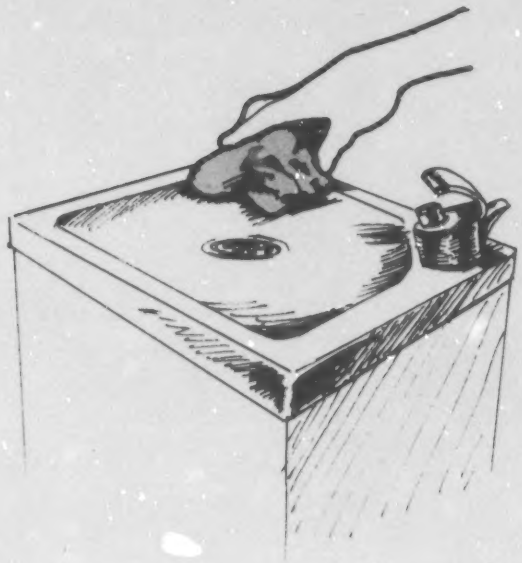


Figure 9-37—If water fountain is stainless steel, use cheesecloth to scrub rather than abrasive pad.

fountain including faucets.

- Scrub top area with abrasive pad.
- If water fountain is stainless steel, use cheesecloth to scrub instead of abrasive pad. (See Figure 9-37.)

Mirrors

- Spray glass cleaner on mirror and wipe dry with pad of cheesecloth or paper towel. (See Figure 9-38.)

Storage

- Rinse and wring dry acrilan swab and abrasive pad; store on custodial cart.
- Rinse sponge mop and hang in custodial storage room.
- Rinse cheesecloth at end of day and hang to dry. Dispose of worn-out cheesecloth.
- Store APC solution, glass cleaner and rubber gloves on custodial cart.

12 SNOW AND ICE REMOVAL

Job Description

Snow and ice removal take precedence over regular assigned duties. Usually snow and ice are removed from sidewalks, entrances, steps, porches and so forth at beginning and end of work shift.

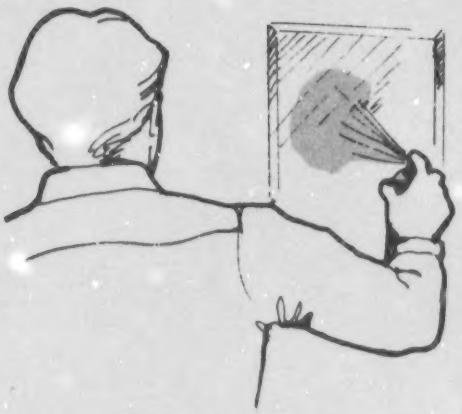


Figure 9-38—Clean mirrors with spray cleaner and cheesecloth or paper towel.

Steps to large trash containers and platforms also must be cleaned of snow and ice before being used.

Precautions

- Ice and snow should be removed at the beginning and end of shift, even if snow is still falling, to prevent accumulation.
- Be careful to use correct lifting procedure when shovelling snow or chipping ice: use legs and not back muscles.
- Remove ice and snow from steps and entrances to prevent melting and refreezing.

Time Guideline

- No estimate possible; varies widely.

Equipment

- Snow shovel (see Figure 9-39)
- Ice chipper
- Push or straw broom
- Sand
- Ice melt
- Snow plow, broom
- Snow blower mounted to grass mowing machine

Procedure

- Procedure and equipment vary with the method used.

Snow Shovel

- Be sure to lift shovel in a way that keeps weight on your legs and not on your back.

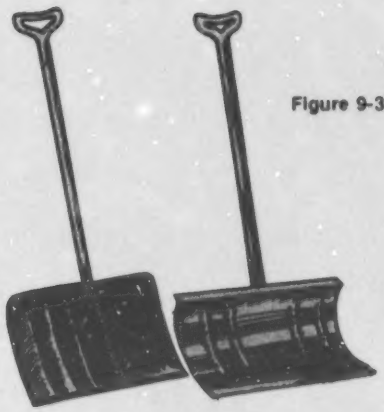


Figure 9-39—Snow shovels.

- Keep back straight.
- Move snow and ice away from entrance and steps.
- Be careful of breaks in walk or steps that might cause shovel to jar.
- Shovel should be inspected before use for damaged spots. Handle should be checked for cracks or splinters.

Ice Chipper

- Ice chipper is used to remove solidly frozen ice. It may be used in an up and down chopping or a pushing action.
- Use with caution to avoid injury or damage to concrete steps and entrance ways.

Push or Straw Broom

- Use to move light snow or snow between gratings.

Ice Melting Chemicals

- Chemicals should be used sparingly to remove ice from steps and entrance ways, as they are tracked into buildings, possibly damaging floor coverings.
- Chemicals may lose effectiveness as temperature drops below 20 degrees.
- Chemicals should be stored in a moisture-proof container in locked storage room.

Sand

- Sand is spread on stubborn areas of ice for traction when ice melt is not effective.
- Sand, like chemicals, should be used sparingly, as it will be tracked into building.

Snow Blower

- The walk-behind snow blower used according to manufacturer's recommendations effectively clears snow from walks. (See Figure 9-40.)
- Unit must be properly maintained and safely fueled according to manufacturer's recommendations.

Care and Storage

All equipment should be cleaned and dried before storing in a locked storage room.

13 SOAP AND PAPER DISPENSERS

Job Description

Replenishing supplies and cleaning soap and paper dispensers.

Safety Precautions

- Watch for sharp edges on dispensers.

Frequency

- Clean dispensers daily. Replenish supplies when there is not enough to last until the next day.

Time Guideline

- 1/4 to 3 minutes per unit

Equipment

- Cheesecloth or cloth pad
- APC spray bottle
- Liquid soap in squeeze bottle
- Roller and/or bifold paper towels

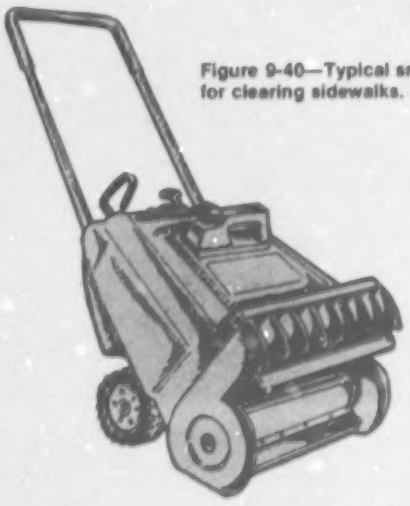


Figure 9-40—Typical snow blower for clearing sidewalks.

Figure 9-41—Replenishing the supply of paper towels in a dispenser.

- Toilet tissue
- Soap dispenser
- Towel cabinet key

Paper Towels Procedure

- Check supply by pushing up on the feeder hole or checking slot in cabinet that shows supply level.
- Unlock cabinet.
- Remove paper wrapper from new package of towels and place towels in dispenser, *fold down*, on top of towels already there. (See Figure 9-41.)
- Lock cabinet.
- Wipe entire surface of dispenser and area around dispenser with a damp pad of cheesecloth. Remove dirt with APC solution as necessary.

Soap Dispenser

- Check level of soap in dispenser.
- If more is needed, remove cap, using tool provided.
- Fill with liquid soap from squeeze bottle. Leave air space at top of dispenser.
- Replace cap and wipe dispenser with a damp pad of cheesecloth.
- Dry and polish with dry pad of cheesecloth.

Toilet Tissue Dispenser

- Replace roll with new roll as needed.
- Wipe holder and surrounding area with a damp pad of cheesecloth.

Storage

- Clean all tools and store on custodial cart in a locked custodial storage room.
- Store towels and paper products on top shelves in a locked storage area. Paper products are kept on top shelves to protect them from possible spilling of liquid supplies.

14 SPOT WASHING—GRAFFITI REMOVAL

Job Description

Removing handprints, smudge marks, gum deposits and graffiti from walls, and spot cleaning of painted or varnished surfaces around light switches and door knobs may be done by an area custodian or a team assigned to the project, depending on the size of the job.

Precautions

- If a ladder is used, do not stand above the third step from the top.
- Do not let water run down the wall or onto the floor, as it will streak.

Time Guidelines

- Three minutes or more depending on size of area, kind of dirt to be removed and other variables.

Equipment

- Cheesecloth or cloth pad
- All-purpose cleaner (APC)
- Spray bottle
- Cellulose or natural sponges
- Sponge mop

Figure 9-42—Spray an all-purpose cleaner solution and rub with cheesecloth or sponge to remove smudges or graffiti from walls.

- 16-quart pail on castors
- Rubber gloves

Spot Cleaning Procedure

- Spray smudge mark with a mild solution of APC and water from spray bottle. (See Figure 9-42.)
- Rub dry with cheesecloth or sponge.
- Do not let APC solution run down the wall or onto the floor since it can leave streaks.

Washing Ceramic Walls

- Spread a mild solution of APC and water on the wall with sponge mop or with a cellulose or natural sponge.
- Do not let water run down wall or onto floor.
- Wipe dry with a clean, dry cellulose or natural sponge.

Storage

- Rinse out cheesecloth and hang to dry. Sponges should be rinsed and wrung as dry as possible.
- Stand sponge mop to dry.
- Rinse and dry out pail.
- All tools and equipment should be stored in a locked storage room.

15 WALL WASHING

Job Description and Frequency

There are several ways to wash walls. Directions below cover hand washing. If a machine is used, follow manufacturer's directions. A regular schedule of wall washing and repainting should be established so that all walls are washed about once every three years and repainted about once every five years.

Precautions

- Avoid spilling cleaning solutions on an unwashed wall. This causes streaks that are difficult to remove.
- Avoid splashing or spotting ceiling.
- Move furniture, pictures and other items carefully to avoid any damage.
- Be sure stepladders and scaffolding are safe and use them carefully. Do not stand above the third step from the top.

Time Guideline

- 1 to 4 hours per 1,000 square feet

Equipment

- Buckets
- Sponges

Figure 9-43—Dust walls lightly before washing. Lift dustmop upward and outward to remove cobwebs without smearing.

- Turkish towels
- Stepladder or scaffolding
- Dust mop
- Broom
- Drop cloths
- All-purpose cleaner (APC)
- Rubber gloves

Procedure

- Assemble tools and supplies in room or area where job will be done.
- Move furniture to the center of the room or into another room if possible. If furniture remains in room, cover it with a drop cloth.
- Remove pictures and other items on walls and place in a safe storage place.
- Dust walls lightly. Use an upward and outward lifting stroke to remove cobwebs without smearing walls. (See Figure 9-43.)
- Set up stepladder or scaffolding and be sure it is safe (see Figure 9-44). Mix recommended amount of APC or similar product in pails.
- Put on rubber gloves.
- Immerse towels or sponge into wash solution and squeeze out excess liquid.
- With towel or sponge, apply liquid to the wall in a corner next to the floor.
- Work from bottom up.
- Wet area about ten feet square, without rubbing.
- Again immerse towel or sponge in cleaning

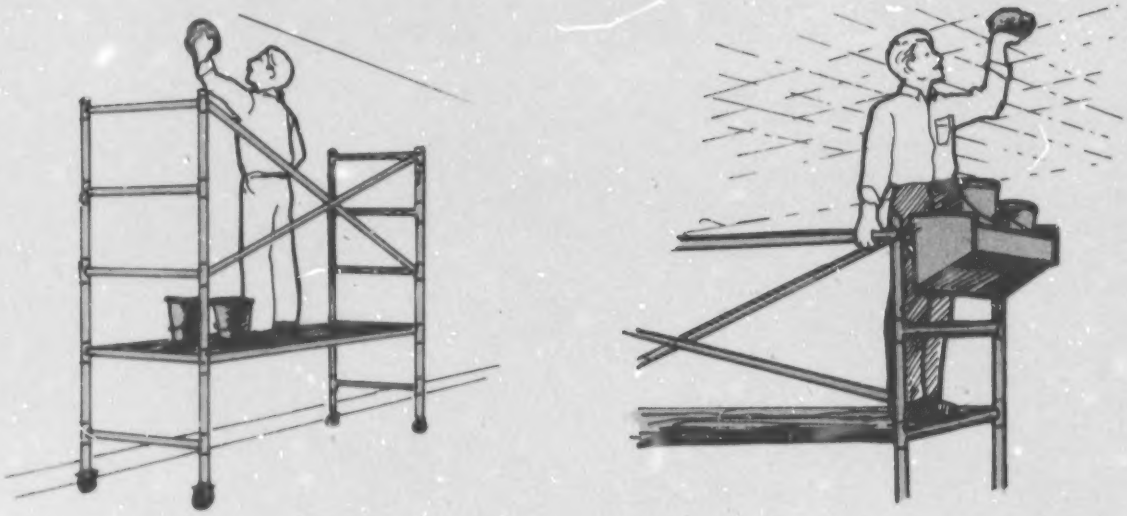


Figure 9-44—Use safe measures in washing upper walls or ceilings from a scaffold or stepladder.

solution; squeeze out excess so it does not drip.

- Repeat washing sequence, but this time apply pressure to clean off soil. A straight rubbing motion, either up and down or side to side is most effective.
- Rinse with sponges or toweling *before* wall dries. Rinse completely, then wipe dry with clean sponges or toweling.
- Repeat operation on adjacent section of wall, overlapping the cleaned area to avoid border marks.
- Wash areas about ten feet square until lower half of wall is finished. Locate stepladder at a corner and begin washing upper half of wall.
- Begin at bottom of upper half and work up. Use the same method as for lower half of wall.
- When solution runs or is splashed onto the clean wall below, wipe it off promptly with a clean damp towel.
- When the room or area is finished, pause and look over job.
- Remove drop cloths and replace pictures and other objects on walls. Return furniture to exact location it was moved from.
- Throughout the job, replace wash and rinse water as they become dirty.
- Empty buckets, wash out towels and sponges, and clean all equipment before storing it in a locked storage cabinet. Wet cloths and sponges should be hung or stored to allow them to dry.

16-1 WASTE REMOVAL

Job Description

Usually trash and paper are gathered and waste receptacles emptied each day. (See Figure 9-45.) Trash must be removed from the building on a regular basis to avoid the danger of fire. Usually trash is dumped into large containers kept outside.

Precautions

- Always check weight of waste containers before lifting, especially in shop areas where heavy wood or metal shavings may be in the trash.

Figure 9-45—A typical waste container.

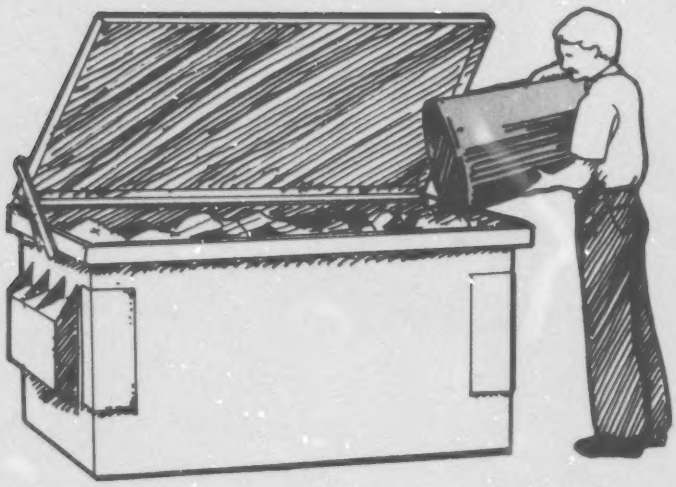


Figure 9-46—For safety, use both hands on outside of container to dump trash.

- Keep hands out of waste containers. Use both hands *on outside* of container to lift and dump trash (see Figure 9-46).
- Do not bend over collector can when dumping wastebaskets.
- Get help to dump a heavy load into the trash collector.
- Use correct lifting procedures, with back straight and knees slightly bent, to avoid straining back.
- Use gloves while dumping trash. In designated areas, wear apron, goggles, and respirator.
- When dumping trash in laboratories, stand as far back as possible from collector can, as trash may contain chemicals.
- If there are steps leading up to large outside collectors, be sure they are free from ice and snow and clear of objects.

Time Guidelines

- 1 to 5 minutes per unit depending on unit size and type of waste.
- 10 to 30 minutes per trip to outside collector, depending on distance, size of containers, and other obstacles.

Equipment

- Custodial cart
- Collector can (see Figure 9-47)
- Metal drum
- Four wheel cart
- Wastebasket
- Leather or leather palm gloves
- Rubber or plastic apron
- Safety glasses or goggles
- Respirator
- Safety shoes

Procedure

- Develop a pattern that avoids doubling back.
- It is usually easier to push a cart than to pull it.
- Reduce flying dust from trash by turning wastebasket over and holding it down inside the receptacle when emptying.
- Check weight of container.
- Lift container with both hands, keeping hands outside container.
- Turn container upside down into collector can. Hold your head back and look away to avoid getting dust in the face or eyes.

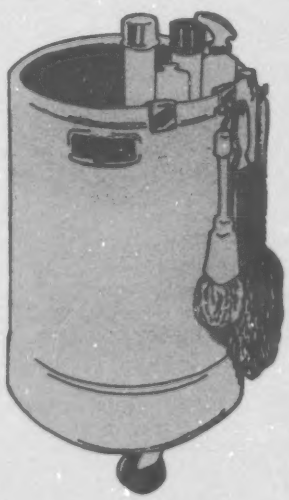


Figure 9-47—A collector can on casters can be equipped with basket and hooks to carry needed supplies and equipment.

- Hold container in this position for a second or two to make sure all dust and debris has settled.
- Use special care when dumping ashtrays to be sure no hot embers are in the ashes, and in dumping pencil sharpeners to make sure shavings do not fly into the eyes.
- When cart or collector can or drum is full, carry trash to large outside collector.
- It is better to make several smaller trips than to try to carry too large a load to outside collector.
- Be sure waste containers are replaced in proper location. Never set containers on table or desk.
- When replacing a container, be careful not to bump walls or furniture.

16-2 WASTE REMOVAL—LARGE CONTAINERS

Job Description

Large trash containers normally are located outside the building because of the possibility of fire. After trash is collected from the assigned cleaning area, it is dumped in the large container.

Precautions

- If there are steps leading up to the collector, use extreme caution. Be sure they are clear of ice, snow or objects. Always be aware of the danger of slipping and falling.
- Be sure lid springs are operable and that the lid has not frozen shut.
- Never get on top of or into a large trash collector.
- Always keep the lids to large collectors closed.

Time Guideline

- 10 to 30 minutes per trip depending on travel time, size of containers, number of steps and so forth.

Procedure

- It is safer and easier to dump several small loads than to overload the collector can.
- Inform supervisor if large trash containers are filled before scheduled pickup.

17 WAXING FURNITURE

Job Description

Office and classroom furniture, such as desks, chairs, tables and files, should be cleaned and waxed regularly to preserve the finish (see Figure 9-48).

Precautions

- When using aerosol type cans, be careful that spray does not get into the eyes.
- Overspray from an aerosol can onto floor surface will leave floor slippery. Wipe up any overspray at once.

Time Guideline

- 5 to 10 minutes per unit, but times vary widely. It is best to develop individual guidelines.

Equipment

- All-purpose cleaner
- Cheesecloth or similar cloth
- Furniture wax
- Pail

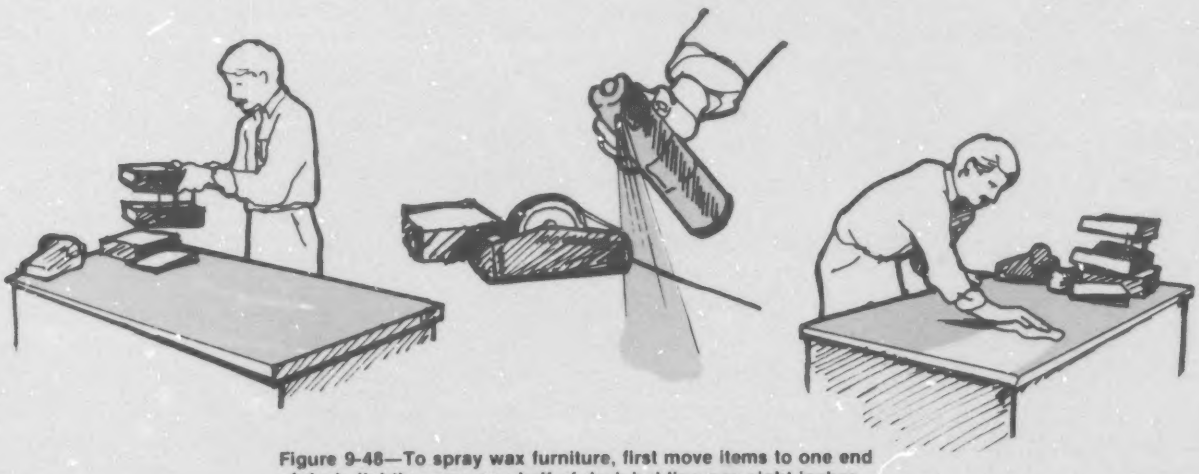


Figure 9-48—To spray wax furniture, first move items to one end of desk; lightly spray one-half of desk holding can eight inches away; wipe immediately with cheesecloth (do not allow spray to dry); then repeat the procedure on the rest of the desk. Replace all items in their original positions.

Procedure

- A regular schedule should be established so that some waxing and cleaning of furniture is done daily or weekly.
- Use a mild solution of all-purpose cleaner and water to wash furniture if wax being used does not serve as a cleaner. Rinse and dry furniture before applying wax.

Liquid Wax

- Follow instructions on container.
- Shake container before using.
- Wet a pad of cheesecloth thoroughly with wax.
- Wipe over entire surface to be treated, using straight movements rather than circular.
- Let wax dry thoroughly.
- Wipe off haze with a clean pad of cloth, turning the pad often.

Wax in Aerosol Can

- Follow instructions on container.
- Shake can vigorously, holding spray nozzle away from you.
- Spray directly onto the surface to be waxed, holding can as nearly upright as possible.
- Wipe with clean piece of cloth

18 WINDOW WASHING

Job Description and Frequency

Typically, custodians work in teams to wash exterior windows and clean venetian blinds. A typical schedule for window cleaning is twice a year, inside and out. If special conditions exist, more frequent cleaning may be needed. Venetian blinds are dusted and washed as needed. Screens and storm windows are usually cleaned once a year.

Precautions

- Exterior window washing is hazardous. Use caution at all times. Follow correct procedures in using ladder and safety belt.
- Check safety equipment carefully before beginning job.
- When washing the insides of windows, never stand on radiators, desks, fans, chairs or other furniture or equipment.
- Never stand above the the third step (or rung) from the top of a ladder.

Time Guideline

- Depending on size and location of window, 8 to 15 minutes per unit.

Equipment for Cleaning Windows

- Ammonia
- Buckets
- Cloth pads
- Detergent pellets
- Hose
- Ladders: straight and step
- Window cleaning telescoping pole with hose and brushes
- Sponges
- Squeegees (6, 10, or 14 inch)
- Window safety belts
- Window cleaner

Equipment for Cleaning Screens

- Hose
- Pistol grip nozzle
- Plastic bristle broom

Procedure for Washing Inside of Windows

- Arrange equipment and prepare supplies.

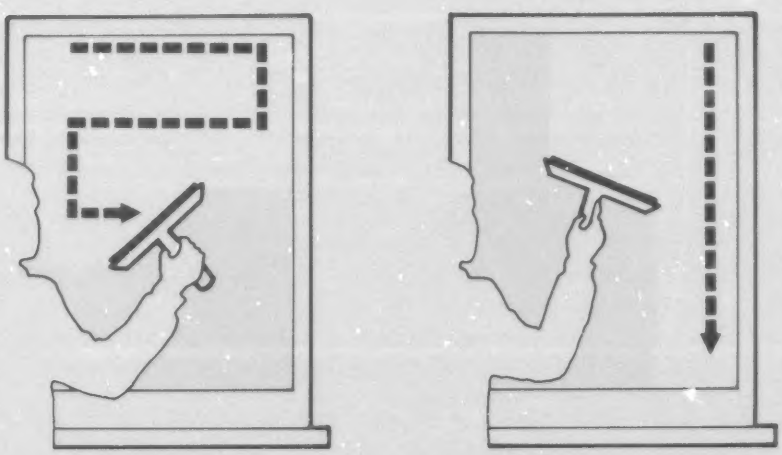


Figure 9-49—Efficient squeegee motions make water run toward trailing edge and away from cleaned area.

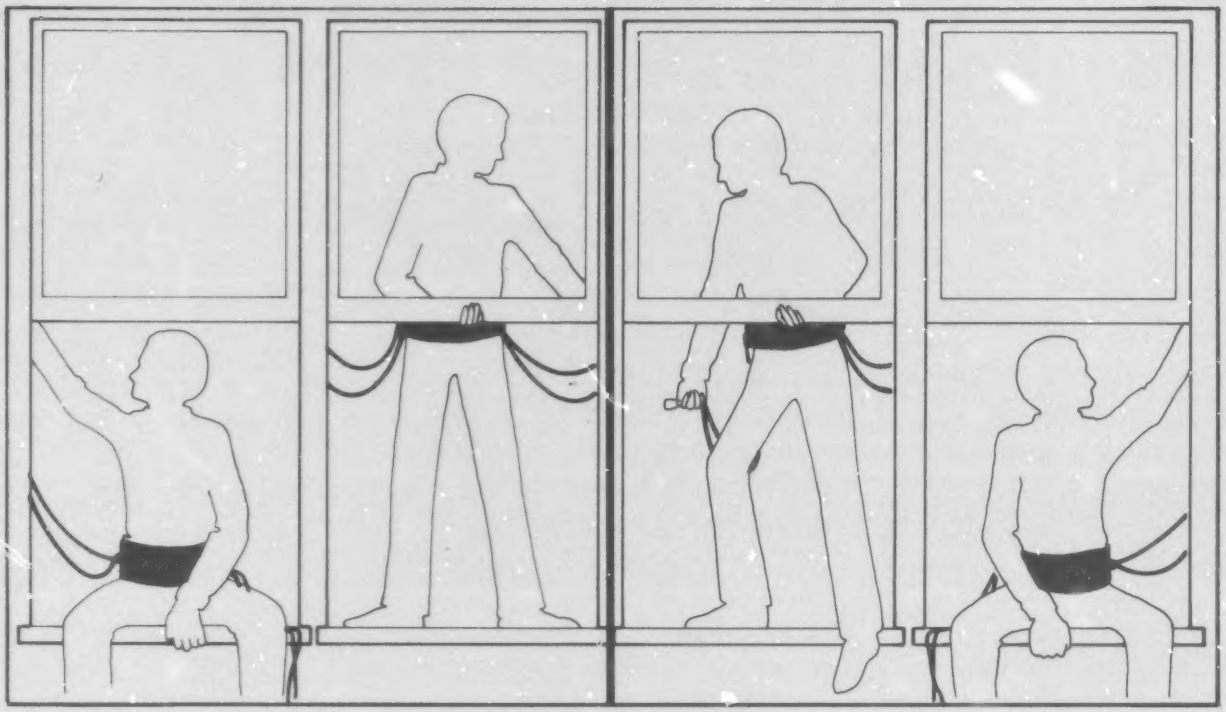


Figure 9-50—To ensure safety, proper procedures must be followed when going outside of a double hung window (left) and re-entering (right) after cleaning.

• Raise venetian blinds or shades and remove all items from window sills. Take care not to damage sills.

• Wash glass with sponge and water, with or without cleaner. Use left-to-right, then up-and-down overlapping strokes to clean entire glass surface. Use stepladder to clean upper sash first.

• Use squeegee to remove water, using either side-to-side or top-to-bottom movements. (See Figure 9-49.)

• If using side-to-side method, make one continuous stroke. Start with squeegee in a vertical position at an upper corner and stroke across to opposite side. Make a half-turn and return. Continue back and forth in overlapping strokes. Excess water will collect in the lower corner of the window.

• If using the top-to-bottom method, move the squeegee in separate strokes.

• With a sponge or cloth pad, wipe blade of squeegee after each stroke.

• Use sponge or cloth pad to wipe up water.

• Check work, then replace items on window sill. Leave blind or shade in the position in which you found it.

Procedures for Washing Outside of Window

Safety Belt Method

• Arrange equipment and prepare supplies. Be sure to inspect belt, checking buckle, ropes and hooks to be sure they are in proper working order.

• Put on safety belt and adjust by holding a hook in each hand and stretching arms outward until hands are about shoulder height. Check rope for proper length.

• To go outside double hung windows, then return: fully open lower window sash, sit on window sill with both legs inside and hold onto sill with one hand. Inspect all window bolts to see that they are anchored and undamaged. Use one hand to hold onto lower portion of window sash and use the other hand to hook the terminal of one side of the safety belt rope to the adjacent window bolt. (See Figure 9-50.)

• Check hook-up by pulling on anchored end of belt. Cautiously rise to a standing position while holding anchored side of rope with one hand and the bottom part of the window sash with other hand.

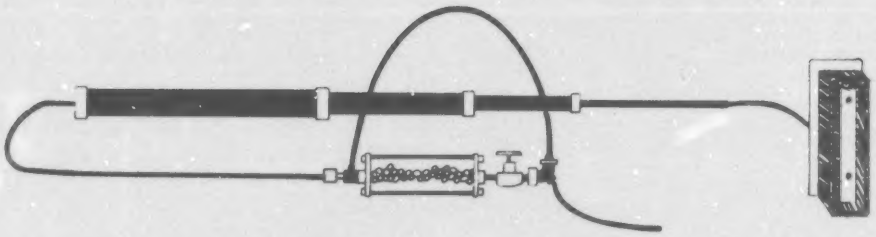


Figure 9-5[illegible]—Window washing pole unit can be connected to a water supply and equipped with a canister of cleaning pellets.

• After balance is certain, move the hand from the anchored rope to the bottom of the sash and use the other hand to hook-up the other end of the rope to the other window bolt.

• Check the hook-up. Lower the raised window sash.

• Use sponge and water, with or without cleaner, to wash glass, starting with the upper sash. After cleaning glass, framework, and sill, prepare to go back inside.

• Fully open lower window sash. Use one hand to hold onto the bottom of the window sash, using the other hand to unhook one end of rope from the window bolt.

• After one end is unhooked, sit down on window sill with both legs inside. Use one hand to hold onto window sill and the other to unhook the second end of the rope from the window bolt. After second terminal is unhooked, return inside and close the window.

Pole Washing Method

• Pole washing procedure may be used to clean water-tight windows which are 50 feet or less above ground.

• Arrange equipment and prepare supplies for work. Up to five people and two pole window washing units may be used. Two people operate one unit to wash windows, two operate the second unit and rinse. The fifth person works inside, closing windows, drying up water that seeps in, and checking the work. (See Figure 9-51.)

Other Methods

• On buildings with windows 50 feet or more above ground level, tubular or swinging scaffolding may be used.

Storage

• All tools and supplies should be cleaned after each use and stored in a locked storage room.

10/Equipment and Supplies

The school custodian uses dozens of different kinds of tools, equipment and consummable supplies. It is important for the custodian to know as much as possible about these items—what they are, how they should and should not be used, and any hazards that might be involved.

This chapter describes more than three dozen of the tools, equipment and supplies typically used by the school custodian. Each description includes an explanation of uses, care and storage, and any precautionary measures necessary.

Items are listed in alphabetical order.

ALL-PURPOSE CLEANER (APC)

All purpose cleaner (APC) is usually a detergent in either powder or liquid form. See Figure 10-1. It should always be used according to manufacturer's instructions. Most APCs are powerful and can cause damage if used in a solution that is too strong. Therefore, check with your supervisor before using extra-strong solutions.

The addition of any other cleaning agent to the chemically-balanced detergent can destroy its cleaning power. If there is a question, check the container for instructions.

Uses

APC may be used for the following jobs:

- Water mopping floors
- Cleaning floors for refinishing
- Daily cleaning of toilet fixtures and drinking fountains
- Spot cleaning
- Cleaning furniture

Care and Storage

Liquid APC is normally received in cans. Powder APC is shipped in air-tight containers. All APC should be stored in a locked, dry custodial storage room.

Caution

Never add anything but water to a cleaning mixture of APC.

Figure 10-1—Various forms of all-purpose cleaner include premeasured packets of powder (left) and liquid in 5-gallon buckets and 55-gallon drums.

ABRASIVE CLEANER

Abrasive cleaner should rarely be used on any surface, and then only for removing stubborn stains. It should never be used on stainless steel or glazed surfaces such as Lexan or acrylic.

After abrasive cleanser is used, the area should be thoroughly rinsed and wiped dry.

Care and Storage

Abrasive cleaner is usually packaged in cans or bottles, and should be stored on shelves in a dry, secure custodial storage room. See Figure 10-2.

Caution

Improperly used, abrasive cleaner roughens the finish and makes cleaning more difficult. Abrasive cleaner should not be used in any daily procedure unless there is no other way to do the job.

Figure 10-2—Abrasive cleaner.

Figure 10-3—Ammonia

AMMONIA

Two or three tablespoons of ammonia per gallon of water is used to clean glass.

Care and Storage

After use, clean the outside of the bottle and store it in a locked custodial area. See Figure 10-3.

Caution

Ammonia is a poison. Avoid inhalation of ammonia fumes. Do not mix other cleaners with ammonia. This is a limited-use product.

BOWL CLEANER APPLICATOR

This applicator (johnny mop) is used with liquid bowl cleaner to clean stools and urinals. See Figure 10-4. Full-strength bowl cleaner or all-purpose cleaner is applied directly on the applicator. Avoid dripping cleaner on floors. All rims, grooves and inside surfaces are scrubbed with the applicator.

Figure 10-4—Various types of bowl cleaner applicators and carrier.

Care and Storage

After use, rinse out the applicator, squeeze out excess water, and hang it to dry on a custodial storage cart in the storage area.

BOWL CLEANER

Bowl cleaner is used to clean vitreous china toilet bowls and urinals only. Under normal conditions, the frequency of use depends on the hardness of the water. Normally once a week is sufficient. See Figure 10-5.

Figure 10-5—Bowl cleaner in dry forms and liquid.

Care and Storage

Supplies of bowl cleaner must be stored on a bottom shelf in the custodial storage room for safety in case of spillage.

Caution

Bowl cleaners contain acid and must be used carefully to avoid injury or damage to property. Do not mix bowl cleaner with any other cleaner. Handle carefully and avoid contact with skin or prolonged inhalation of fumes.

Figure 10-6—Brooms in various types and sizes.

BROOMS

Brooms should be made from cornstraw, equipped with splinter-free wooden handles, and sewn with good quality twine. See Figure 10-6.

Use

Brooms are used to clean rough floors, porches, and, if necessary, wet floor areas.

Care and Storage

Clean brooms and store in a rack in a locked custodial storage room so that no weight or pressure is on the straw.

CHALK AND ERASERS

Generally dustless chalk is used. Most erasers used are double-sewed felt erasers.

Use

Two or three long pieces of chalk and one eraser

Figure 10-7—Chalk and eraser.

should be provided for each three to four foot section of blackboard unless other directions are given. See Figure 10-7.

Care and Storage

Small supplies of chalk and erasers should be carried on the custodial cart. Larger supplies of chalk and erasers should be stored on the shelves in the locked custodial storage room. Extra supplies may be left with teachers if requested.

CHEESECLOTH/CLOTH PADS

Cheesecloth is packaged in 70-yard bolts. Cloth pads are available in various types of packaging. See Figure 10-8.

Figure 10-8—Cheesecloth in large bolts and pads.

Use

Cheesecloth or cloth pads are used for many cleaning operations.

Approximately one yard of cheesecloth makes a good pad which can be used for: cleaning and drying of drinking fountains, toilet fixtures, mirrors, and glass surfaces; washing and waxing furniture; spot cleaning painted walls, partitions, and doors; damp wiping ash trays; cleaning toilet seats, and many other purposes.

A small pad of cheesecloth or a readymade pad

can be carried in the custodian's pocket at all times for quick dry dusting.

Care and Storage

Bolts of cheesecloth or boxes of cloth pads should be stored on a shelf in the locked storage area. Used cheesecloth or pads may be rinsed and hung up to dry in the storage area, then reused.

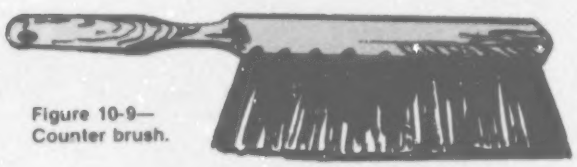


Figure 10-9—Counter brush.

COUNTER BRUSH

An eight-inch, soft black horsehair, staple-set bench brush or the equivalent makes an acceptable counter brush. Handles should have a hole or screw eye for hanging the brush on the custodial cart. See Figure 10-9.

Use

The counter brush is used with a dustpan to pick up soil after sweeping or dustmopping, and to clean soil from hard-to-get-at areas. A toy broom also may be used with a long-handled dustpan for the same purposes. See Figure 10-10.

Figure 10-10—Toy broom and dust pan with a long handle (lobby pan).

Care and Storage

Clean counter brush bristles with the edge of a dustpan, and hang on custodial cart.

CUSTODIAL CART

The custodial cart is a "closet on wheels." The school custodian carries most of the supplies and tools needed for the day's work. The cart is also used to transport waste from the building to the trash collection area.

There are several types of carts:

- Some carts may have a detachable collector can for waste and several shelves for storage of supplies and equipment. Some models have broom or mop holders and hooks to hang equipment. See Figure 10-11.
- The collector can on casters is a light weight

Figure 10-11—Here are three of the many ways to equip custodial carts for different needs.

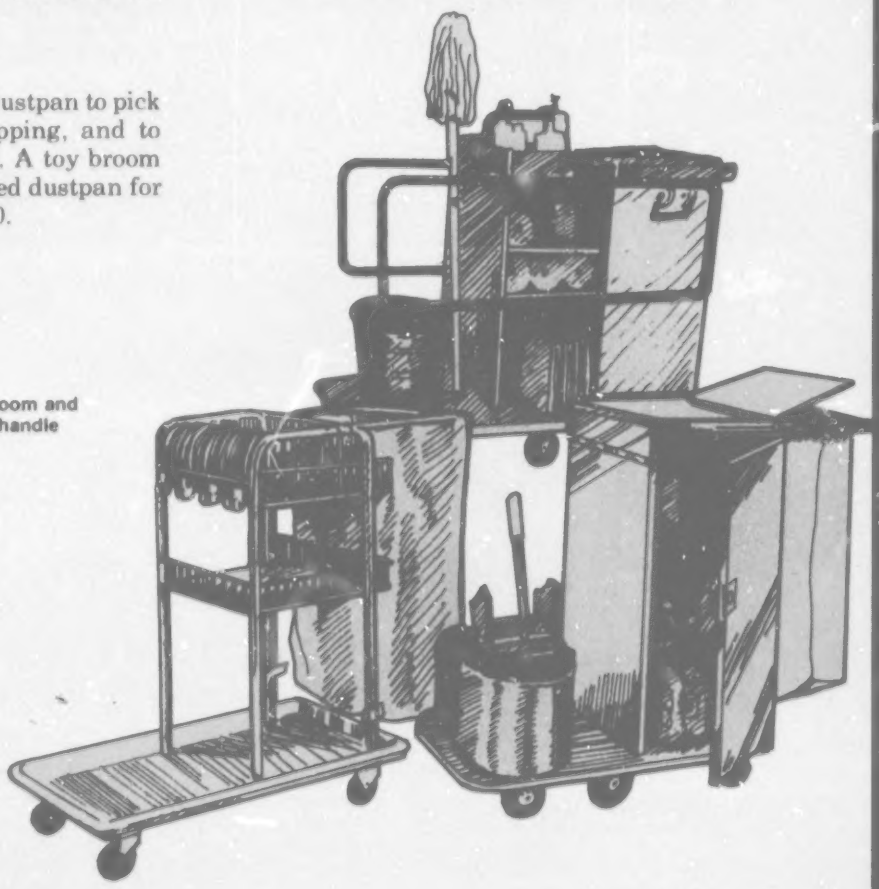


Figure 10-12—A collector can on castors, which may be equipped to carry supplies (see Figure 9-47 on page 71).

waste container, which may be equipped with a half-moon basket for supplies that fits inside the container. See Figure 10-12. Hooks for equipment may be installed on the sides of the can. (Collector cans without casters are used for collecting waste in congested areas in buildings without elevators, and can be carried up and down stairs.)

- Four-wheeled platform trucks with one or two 55-gallon metal drums are used to collect waste in laboratories. They may or may not be equipped with shelves for carrying tools and supplies. See Figure 10-13.

Use

The cart should be stocked at the end of the shift with supplies needed for the next day. This eliminates extra trips back to the supply room.

In large open areas, the cart should be taken into the room to eliminate as many steps and as much doubling back as possible. If the cart cannot be taken into the room, remove the collector can and take it into the room with supplies and tools needed to clean that room.

In smaller areas, the custodian may use only the collector can with half-moon insert to carry supplies.

The custodian should always keep the cart as close to the work area as possible, and should never overload the collector can. It is easier and safer to make two trips to the large trash containers than to handle an overloaded can.

Care and Storage

All custodial cart waste containers should be emptied at the end of each day's use. Each custodian is responsible for keeping his/her cart clean and neat. The cart should always reflect the professional image of the school custodian.

All carts should be stored in a locked custodial storage room.

DUST PAN

The short-handled dust pan is constructed of one piece of steel and painted with black enamel. Long-handled dust pans are available as well and may be used with a toy broom. See Figure 10-14.

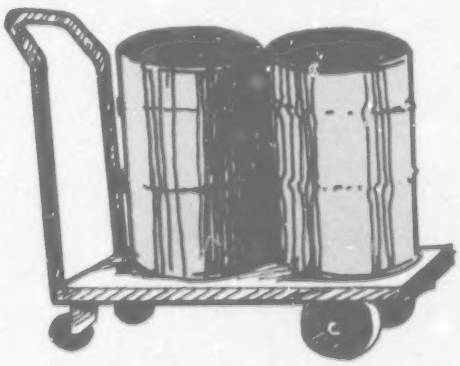


Figure 10-13—A platform truck with metal drums.

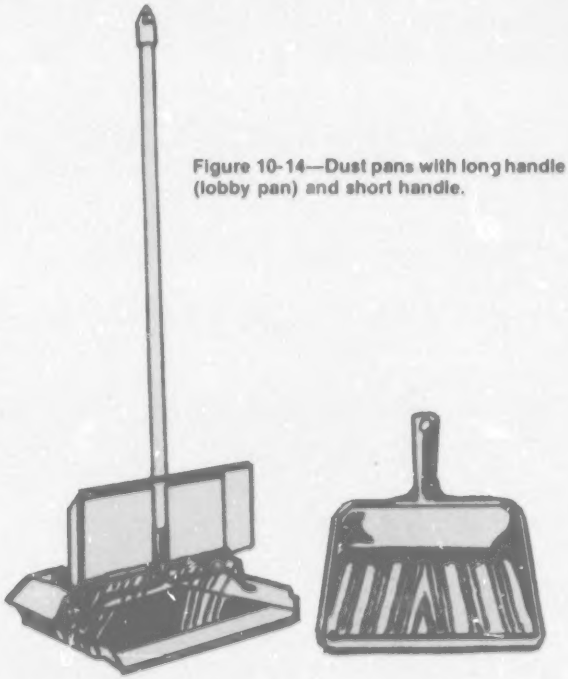


Figure 10-14—Dust pans with long handle (lobby pan) and short handle.

Use

The dust pan is used with a counter brush or a toy broom to pick up accumulated soil after sweeping or dustmopping.

Care and Storage

Clean soil from dust pan and hang on custodial cart for convenience.

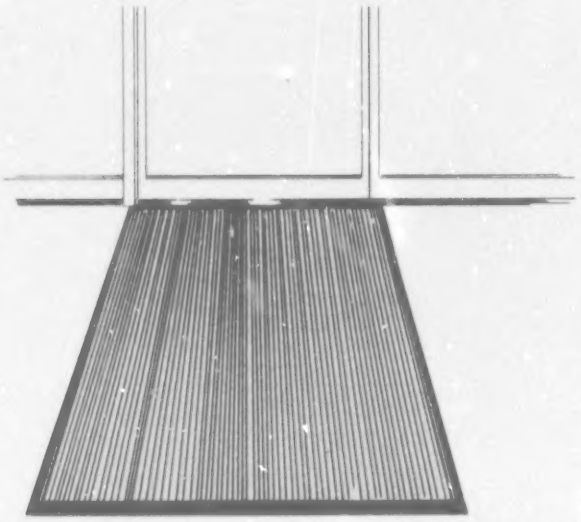


Figure 10-15—Carpet entrance mat catches dirt before it can be tracked further into the building.

ENTRANCE MATS

There are many types of entrance mats, including link-rubber entrance mats, corded rubber mats used outside the entrance, and walk-off mats used inside. All are available in various sizes to provide building occupants a place to remove dirt and water from their shoes. See Figure 10-15.

Care and Storage

Carpet-type mats are vacuumed periodically and thoroughly scrubbed as needed. Surfaces under recessed mats should be cleaned as needed, at least once a month.

All door mats are kept in locked storage rooms when not in use.

FLOOR BRUSH

Push brooms or floor brushes are available in various widths. The width used depends on the size and congestion of the area to be cleaned. See Figure 10-16.

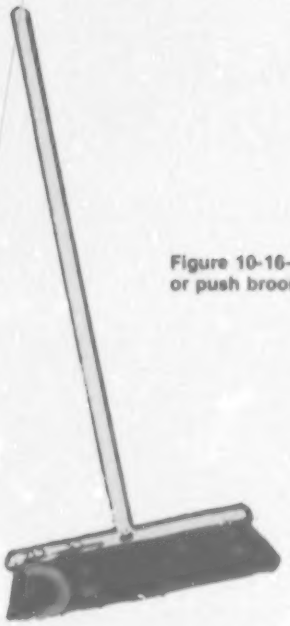


Figure 10-16—Floor brush or push broom.

Use

Push brooms are used on rough floors for removal of heavy dry soil. Width of brush and length of handle should be carefully selected to reduce fatigue.

Care and Storage

Clean and store the broom in a broom rack in the locked custodial area so that no weight or pressure is on the bristles. Never store brooms near heat pipes or radiators. Comb bristles as needed. Periodically change the position of the broom handle.

Caution

Do not use a push broom to sweep wet floors unless it is made with synthetic bristles.

FLOOR MACHINES

Floor machines are available in many brands and sizes. Normally, a 17-inch to 21-inch machine is used in schools, but select a size according to the area where it will be used. See Figure 10-17.

Use

Floor machines are used to refinish both hard and soft (resilient) floors and to shampoo carpets, according to manufacturer's instructions.

Care and Storage

After use, clean machine according to manufacturer's instructions and store in a locked cus-

Figure 10-17—Floor machines in various sizes.

todial storage room. Before using, check the machine and electrical cord for possible needed repairs.

FUNNELS

One-pint plastic or metal funnels are useful for transferring liquids from one container to another. Always clean all spillage. See Figure 10-18.

Care and Storage

After use, clean and store funnel in storage area.

Caution

Do not use a metal funnel for acid-type cleaners.

Figure 10-18—Typical funnel.

FURNITURE POLISH

Furniture polish may be purchased in one-quart and other sizes, according to need. See Figure 10-19.

Figure 10-19—Furniture polish.

Use

Furniture polishes are used to clean and restore the surfaces of various types of furniture. Always follow instructions printed on the container label. Also check waxing instructions received with furniture for the best type of product to use.

Care and Storage

After use, clean outside of container and store it in a locked custodial storage room.

GEAR PRESS MOP UNITS

Gear press mop units are available in the 16-quart mop pail and downward pressure wringer unit and the 32-quart mop unit. Both units are equipped with casters. The 16-quart unit may be used in congested areas and the 32-quart unit in larger areas. See Figure 10-20.

Use

Gear press mop units are used daily in wet mopping. In using the 32-quart unit, fill the pail with three to four gallons of water. Fill the 16-quart unit with one and one-half to two gallons of water. Wherever possible, fill unit and empty waste water at a service sink.

Care and Storage

After use, rinse and wipe out the pail and store it

Figure 10-20—Typical mop buckets with press-type wringers.

Figure 10-21—Glass cleaner in a spray bottle.

upside down in the locked custodial storage room. Clean and store the wringer. Clean outside surfaces of the pail as needed. Oil casters as needed.

GLASS CLEANER

Window glass cleaner is used to clean all types of inside glass, such as display cases, desk tops and bookcases. See Figure 10-21.

Care and Storage

Keep outside of container clean. Store in a locked custodial storage area.

HAND DUSTER

A hand duster is normally 24 inches long and has a strong, rigid wire frame and a hardwood handle, which must have an eyelet or quarter-inch hole for hanging. Duster head is cotton yarn, double-stitched to sanforized canvas or a similar synthetic material. See Figure 10-22.

Use

Duster head is treated with a dust controllant to pick up dust and avoid transferring it from one place to another. Most horizontal and vertical surface dusting is done with a hand duster.

Care and Storage

Hang the duster on the custodial cart and store it in a locked storage room. When the duster no longer holds dust, remove handle and place the duster in a designated area provided for pick up and laundering.

Newly-laundered and treated duster heads

Figure 10-22—Hand dusters with removable duster heads.

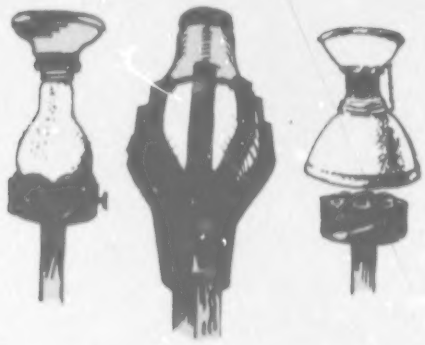


Figure 10-23—Light bulb changers for various types of bulbs.

should be neatly stacked on the shelves in the storage room. Do not remove plastic covering from the duster until ready to use. Since treatment dries out, always use the dusters in order received and never overstock the supply.

LIGHT BULB CHANGERS

Several types are available to change recessed or exposed bulbs. See Figure 10-23.

Care and Storage

Check changer for damage after each use. Store in a secure custodial storage room.

Caution

Always exercise caution when working with electricity.

METAL POLISH

Shake the container well before using. Put a little polish on a damp pad of cloth or a damp paper towel. When stains and tarnish are removed, allow polish to dry. Then polish metal with a clean pad of cloth. Normally, cleaning metal is a periodic procedure.

Care and Storage

Polish may be stored on a custodial cart or on shelves in the custodial storage room. Outside and top of containers should be wiped clean after each use.

Caution

Most metal polishes may be used on most types of metal—copper, pewter, silver, brass, aluminum, nickel, bronze, tin, zinc; however, check instructions on the container.

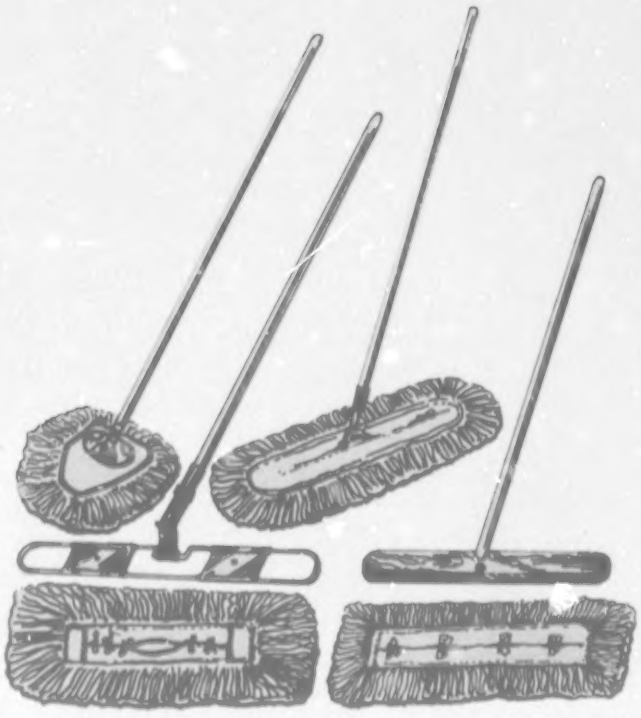


Figure 10-24—Dry mopheads and handles.

MOPHEADS/STICKS (DRY)

Mopsticks with cotton mopheads are used for dry mopping (dust mopping). See Figure 10-24. Dry mops specially treated with a dust controllant are never used for wet mopping. Wedge-shaped mops are used for dry mopping in congested areas and on stair steps and may also be used for overhead dusting.

Care and Storage

Inspect mop after each work period and shake it out thoroughly to remove loose dirt. Inspect handle to make sure it is smooth and free of splinters. Broken or damaged handles should be exchanged for new ones. Soiled mopheads which have been treated with a dust controllant are gathered and placed in an assigned area for pickup, laundering and retreatment.

Treated mopheads tend to dry out in storage, so they should never be stored longer than two to three weeks, even if they are packaged.

MOPHEADS/STICKS (WET)

Mopheads used for wet cleaning are made from

Figure 10-25—Wet mopheads and handles.

white cotton stock bound with fabric tape which is securely sewn with lock or chain stitching. See Figure 10-25. The handle must have a smooth finish. Several types of mopsticks are available.

Care and Storage

Inspect mops after each work period. Be sure handles are smooth and free from splinters. Replace broken handles. Thoroughly clean and rinse mophead and spread out to dry.

OIL DRY

Oil dry is a compound used in shops, garages or other areas where oil drippings are a problem. The drippings are sprinkled with oil dry, which absorbs the oil. Then the saturated oil dry is removed by sweeping.

Care and Storage

Oil dry is stored in a dry location in a locked custodial storage room. Clean any spillage promptly.

PAILS

Twelve-quart pails are used in many cleaning procedures, including cleaning blackboards, washing and waxing furniture, spot cleaning and others. They may be metal or plastic. See Figure 10-26.

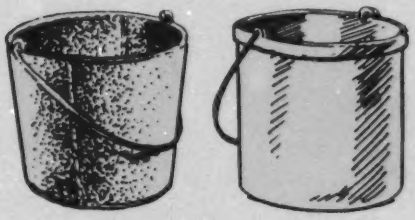


Figure 10-26—Pails in metal and plastic.

Care and Storage

Thoroughly rinse the pail before storing it in the custodial storage room.

Caution

Never put an acid-type product in a galvanized pail, as the pail may be damaged.

Figure 10-27—Plumbers friend.

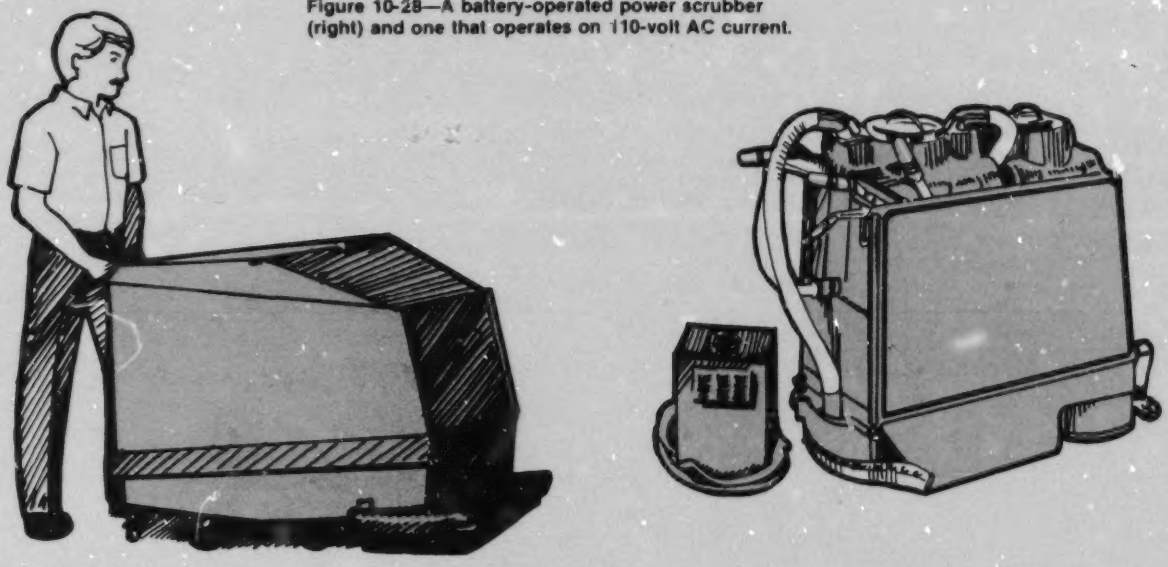
PLUMBER'S FRIEND

A plumber's friend is a force cup on a handle, used to unplug drains in lavatories, urinals and stools. See Figure 10-27.

Use

Use a wet paper towel or pad of cheesecloth to temporarily seal off the air vent of lavoratories. Set the cup over the drain hole like a stopper. Push down on the handle to flatten the cup. Then pull the plunger out quickly. Do this several times to loosen

Figure 10-28—A battery-operated power scrubber (right) and one that operates on 110-volt AC current.



the material that is stopping the drain. If drain is still plugged, report it to your supervisor.

Care and Storage

Clean after use and store in a locked custodial storage room.

POWER SCRUBBERS

At least two types of power scrubbers are available: battery-powered, self-propelled machines with a portable battery charger and 110-volt electric power scrubbing machines. See Figure 10-28.

Use

These machines are used to wet clean large open areas. Unless the work amounts to some two hours of hand wet mopping, it may not be economical to use a power scrubber.

Use according to manufacturer's instructions for individual machines.

Care and Storage

Clean and drain the tanks of each machine prior to storage.

Caution

Charge battery-powered machines only in a well-ventilated area.

POWER SPRAY CLEANERS

The power spray cleaner is used to clean swimming pools, shower stalls, toilet areas and to remove graffiti from exterior walls. See Figure 10-29.

Use according to manufacturer's directions for individual machines.

Care and Storage

After each use, thoroughly clean machine, dry it

Figure 10-29—Power spray cleaning units.

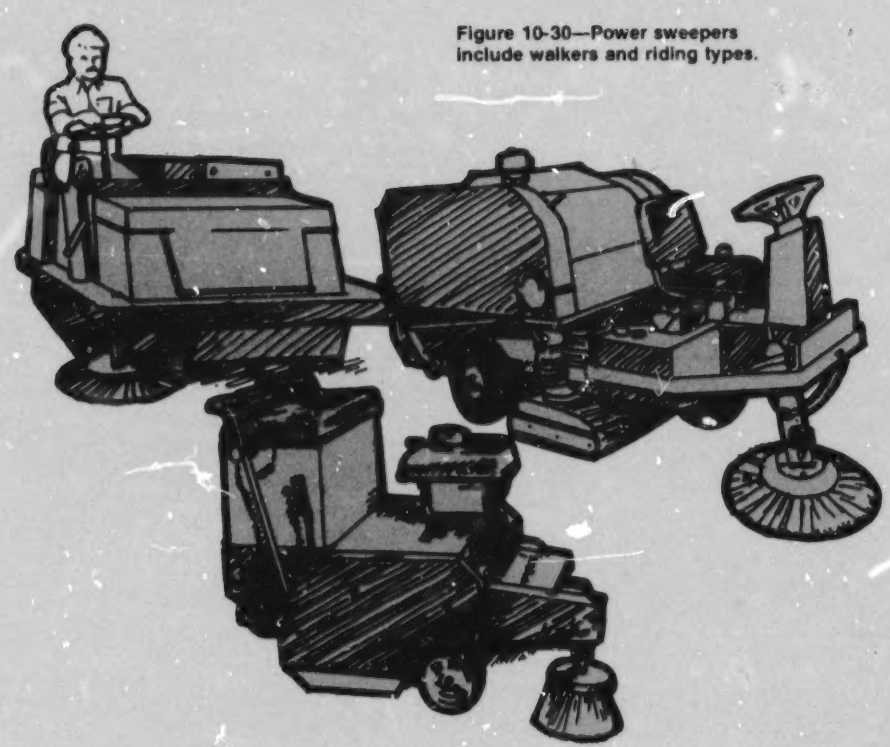


Figure 10-30—Power sweepers include walkers and riding types.

and store in a secured custodial storage room.

POWER SWEEPERS

Gasoline powered, self-propelled power sweepers are used to sweep large open areas. See Figure 10-30.

Use according to manufacturer's instructions for individual machines.

Care and Storage

After each use, the machine's dirt-catching hopper should be emptied, the filter cleaned, and the oil checked.

Periodic maintenance should follow manufacturer's directions.

PUTTY KNIFE

A one-inch elastic putty knife is used to remove gum and other sticky soil from floors. See Figure 10-31. Gently pry soil loose, using care not to mar the floor covering.

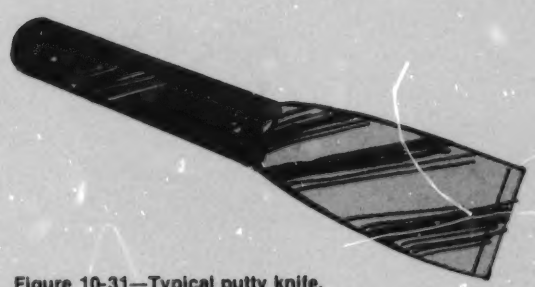


Figure 10-31—Typical putty knife.

Care and Storage

Store on the custodial cart or in a locked custodial storage area.

Figure 10-32—Radiator brushes.

RADIATOR BRUSH

The radiator brush is approximately 30 inches long, with a wooden or metal handle. See Figure 10-32. It is used to clean between coils, behind and under radiators.

Care and Storage

Hang on the custodial storage cart.

Figure 10-33—Scrub brushes come in a variety of shapes and sizes.

SCRUB BRUSHES

A scrub brush normally is made with a palmetto fiber and may have a long handle. See Figure 10-33.

Use

The scrub brush is used in the cleaning of swimming pools and may be used in other areas where it is not practical to use power scrubbing machines.

Care and Storage

After use, thoroughly rinse the brush and store it in the custodial storage room. The weight of the brush should not rest on the bristles.

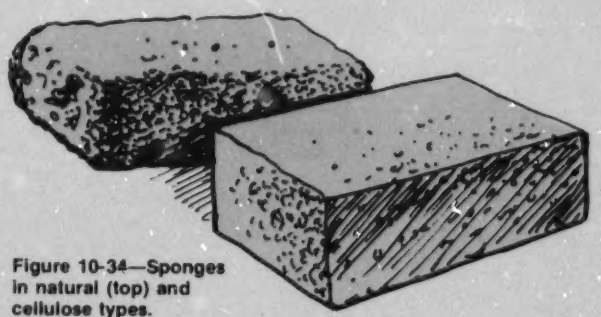


Figure 10-34—Sponges in natural (top) and cellulose types.

SPONGES

Natural and cellulose sponges are used in a number of cleaning jobs. See Figure 10-34. Large sponges may be used to wash chalk boards and smaller ones for spot cleaning and similar tasks.

Care and Storage

Sponges are expensive and proper care is important for long life. After use, wash out the sponge and store it in the custodial storage room in a spot where it will dry completely.

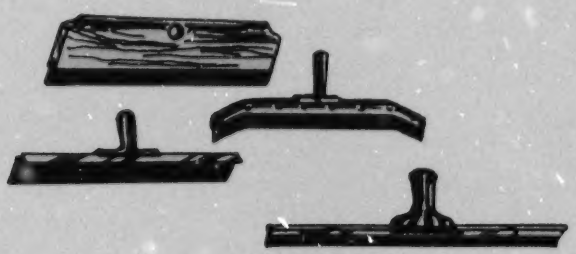


Figure 10-35—Floor squeegees.

SQUEEGEES (FLOOR)

Floor squeegees, available in many shapes and sizes, are used to push water or cleaning liquids on floors to a drain or a place where the liquid can easily be removed. See Figure 10-35.

Care and Storage

Wipe blade dry and inspect after each use. Replace blade as needed. Store the squeegee in a locked custodial storage room so that its weight is not on the rubber blade.

Figure 10-36—Window squeegees.

SQUEEGEES (WINDOW)

Window squeegees, which are used to clean glass, chalk boards and windows, are available in several sizes: 8, 1[illegible], 14 and 18 inches. Rubber refills may be purchased in three-foot lengths and cut to size. See Figure 10-36.

Care and Storage

Wipe blade dry and inspect after each use. Replace blade as needed. Store squeegee on a hook in custodial storage room so that its weight is not on the rubber blade.

STEPLADDERS/SCAFFOLDS

Several sizes of heavy duty, rungback, safety platform ladders and scaffolding are available. Select a size according to need. See Figure 10-37.

Use

Place stepladder or scaffolding in a secure position and test it before performing any work from it.

Cautions

In using a stepladder or scaffold, always maintain a stable position. Never work above the third step from the top on a stepladder.

Care and Storage

After use, store the stepladder or scaffold in a locked custodial storage room. Clean equipment as needed so it always has a neat appearance.

Check equipment for safety before each use.

Figure 10-37—Scaffold (left) and platform ladders.

STREET BROOMS

Heavy duty street brooms with extra heavy hardwood handles are best. See Figure 10-38.

Use

Street brooms are used to clean machine shop

Figure 10-38—Heavy-duty street broom.

floors made of wooden blocks. They also are used to clean rough floors, ramps, and exterior areas such as streets or sidewalks.

Care and Storage

Clean and store the broom in a broom rack in the custodial storage room so that no weight or pressure is on the fibers. Reverse position of handle periodically to allow even wear.

Figure 10-39—Tank-type liquid sprayer.

TANK SPRAYERS

Tank-type liquid sprayers come in a variety of sizes. Select according to planned use. These units may be used in toilet room cleaning or for spraying on finish. See Figure 10-39.

Care and Storage

Thoroughly clean, dry and store in a secure custodial storage room after each use.

TOILET SUPPLIES

Toilet supplies are checked and replenished as needed. These include:

- Toilet paper. Install at least two toilet paper holders in each stall so extra paper is always available. See Figures 10-40 and 10-41.

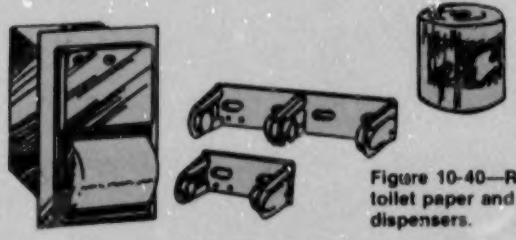


Figure 10-40—Roll type toilet paper and dispensers.

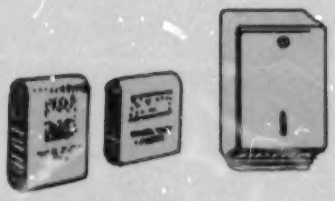


Figure 10-41—Tissue type toilet paper (single and double fold) and dispenser.

- Wax bags. These are used to line sanitary napkin receptacles. If they contain waste, they are removed and the receptacle relined with a new bag.
- Sanitary bags are placed on back of the door (or other suitable location) in each stall in all women's toilets. See Figure 10-42.

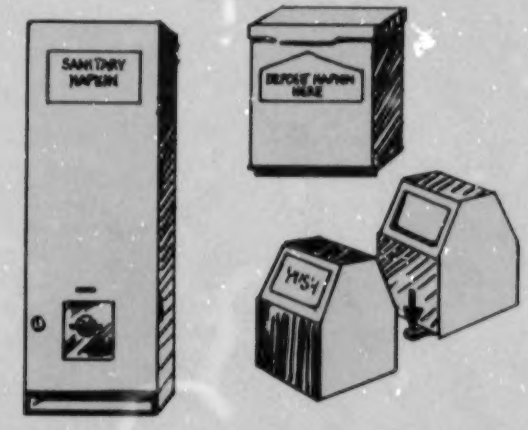


Figure 10-42—Sanitary napkin dispensers and receptacles.

- Toilet soap is placed in dispensers provided. Liquid toilet soap normally is available in one- or five-gallon containers. Granular toilet soap is ordered by the pound. See Figure 10-43.

Figure 10-43—Liquid soap and two types of dispensers.

Care and Storage

All toilet supplies are stored in the locked custodial storage area, in a place where they will not become soiled. All dry supplies should be stored on upper shelves to avoid damage by leakage or accidental spillage of liquid supplies.

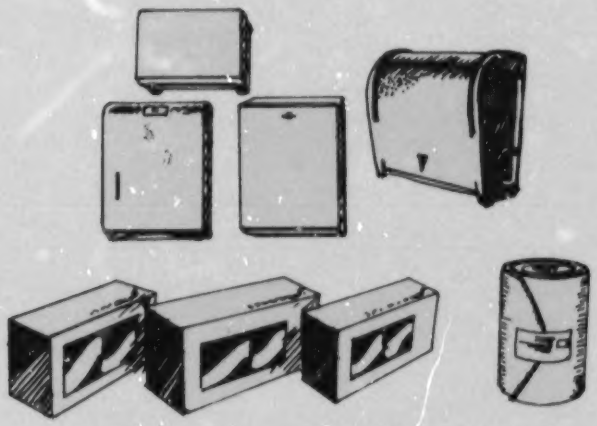


Figure 10-44—Towel cabinets (above) and paper towels come in various types—C-fold, single fold, multi-fold, and rolls.

TOWEL CABINETS

Towel cabinets are located in all toilet areas and in laboratories and other locations. The custodian is responsible for periodic service checks to replenish the towel supply, as needed, with folded and rolled paper towels. See Figure 10-44.

Use

For instructions in operating cabinets, see the inside of each cabinet. In addition to replenishing supplies of towels, the custodian should dust towel cabinets daily and spot clean as needed. Soiled paper towels are placed in a waste container which is emptied daily or as needed.

Care and Storage

Supplies of towels should be neatly arranged on shelves in the locked custodial storage room, above any liquids to avoid damage by spillage or accidental leakage.

TREATMENT, DUST MOP

Dust mop treatment is an aromatic liquid chemical used to treat cotton strand and other dust mops. The chemical aids in collecting dust and loose dirt from sealed, finished or waxed floors of all types.

Use

Amounts used vary with floor type and condition.

A mophead may be refurbished periodically by sprinkling a few ounces of treatment on it to keep it from drying out. If a newly-treated mop leaves streaks on the floor, it is not ready for use and should be allowed to stand and "cure" longer.

When the newly-treated mop leaves dust on the floor, it does not contain enough dust control treatment and should be lightly sprinkled with more treatment and allowed to stand overnight.

Care and Storage

After use, clean the outside of the mop treatment can and store it in the locked custodial storage room. Never store a treated dry mop or mop treatment near hot pipes.

Caution

Excessive use of treatment on mops may damage soft floors. Some mop treatments are flammable and should be avoided.

VACUUM CLEANERS

Several types of vacuum cleaners are available:

- Wet-dry vacuum cleaners are used to remove liquids from floors in wet mopping or in case of flooding. See Figure 10-45.
- Upright brush-type vacuum cleaners are part of the custodial equipment in any school with rugs

Figure 10-45—Wet-dry vacuum cleaner picks up liquids, such as in wet mopping.

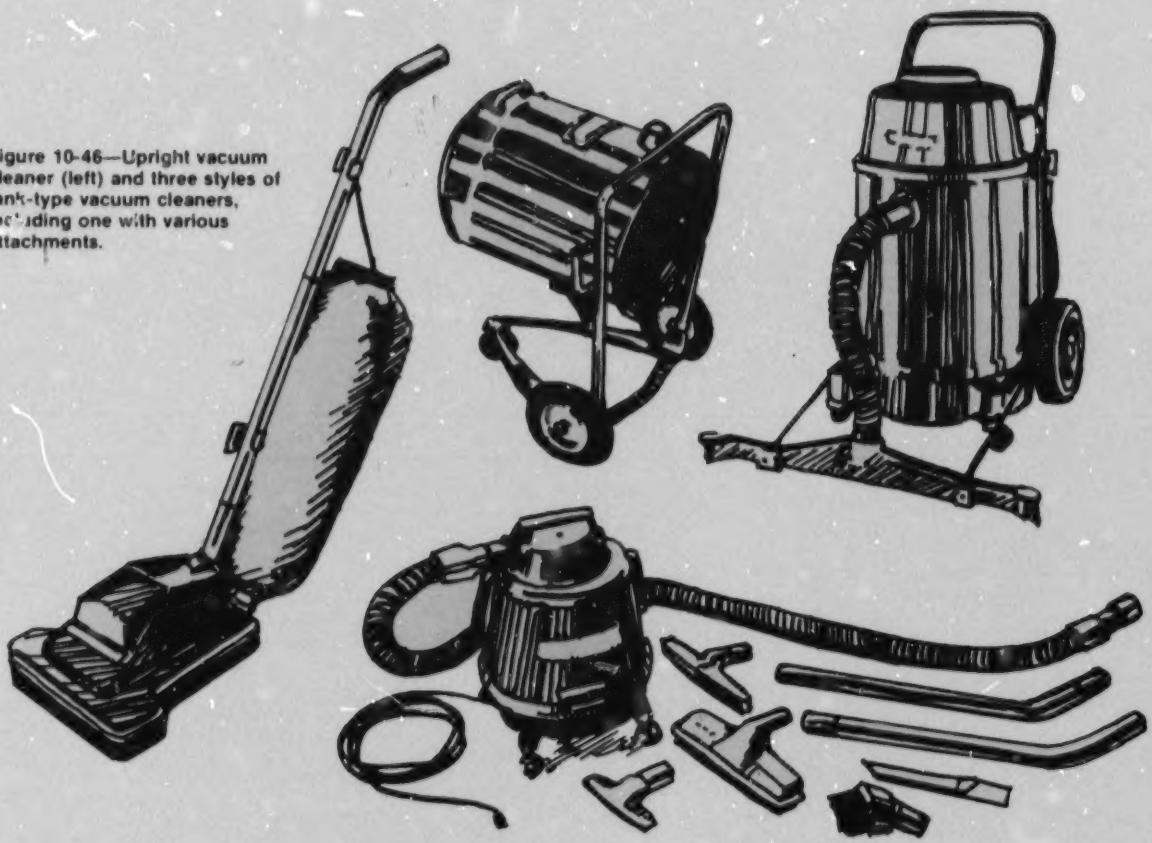


Figure 10-46—Upright vacuum cleaner (left) and three styles of tank-type vacuum cleaners, including one with various attachments.

or carpets. See Figure 10-46.

- Tank-type dry vacuum cleaners are used to remove dust or dirt.

A dry vacuum cleaner should not be used to remove liquids.

Use

All rugs or carpets should be vacuumed regularly, as this increases the life of the rug by removing sharp gritty particles that can grind the fibers.

Vacuum cleaners have several parts and attachments for specific uses. See the manufacturer's directions for each machine.

Care and Storage

Vacuum cleaners should be properly cleaned after each use, following manufacturer's directions. Needed repairs should be reported to the supervisor. All vacuum equipment is stored in a locked custodial storage room.

WASTEBASKETS

Several sizes and types of wastebaskets may be used. See Figure 10-47. These should be located throughout the school where they will be used by building occupants.

All wastebaskets should be emptied regularly. Care should be taken to avoid striking furniture and walls with the wastebasket.

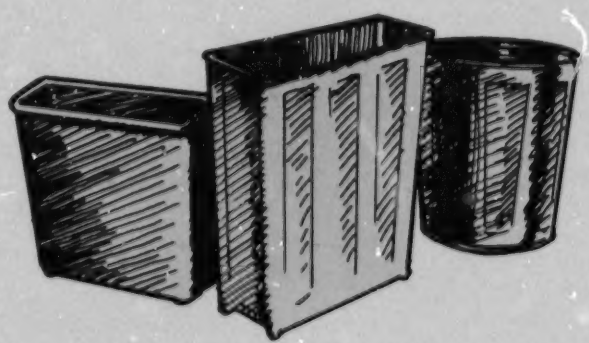


Figure 10-47—Wastebaskets typically located throughout the school.

11/A Custodian's Glossary

The following glossary defines most of the technical terms that are used throughout this manual, as well as those that are commonly encountered in manufacturers' instructions for using equipment and supplies. The glossary is reprinted with permission from *The Glossary of Environmental Sanitation*, published by the Environmental Management Association, 1019 Highland Avenue, Largo, Florida 33540.

Abrasive Cleaners—Cleaning agents consisting of granular materials such as finely ground silica, volcanic ash, powdered feldspar and powdered pumice. Abrasive cleaners may be used periodically to remove discolorations and certain stains from lavatory porcelain and stubborn spots from other surfaces.

Acid Cleaners—Usually formulated to meet a specific problem, acid cleaners include: powdered and liquid bowl cleaners for removing lime encrustations from stools and urinals, citric acid solutions for damp-wiping bronze trim and for nonstreak washing of stainless steel, and buffered phosphoric compounds for cleaning exterior aluminum trim. Acid cleaners are often employed on a regular cycle to neutralize cleaners which are alkaline.

Alkaline Cleaners—Balanced powdered cleaners composed of alkaline salts such as trisodium phosphate, sodium carbonate, modified soda and sodium metasilicate. Besides their detergent properties, certain alkaline salts have water-softening characteristics and are combined in the cleaning product for that purpose. Such products would be above 7.0 on the pH scale (see pH).

All-Purpose Cleaner (APC)—Powder or liquid cleaner which is designed to clean, disinfect, sanitize and deodorize in one operation.

Ammonia—Alkaline chemical used for cleaning and to increase cleaning abilities of detergents and wax removers. May be used as a pH stabilizer for floor finishes and detergents.

Biodegradability—Susceptibility of a detergent to decomposition during sewage treatment as result of bacteriological action on organic matter which reduces foaming.

Carpet—Floor covering, installed wall-to-wall, manufactured from various types or combinations of fabric.

Cleanability—Ease with which an object or surface may be returned to its original condition after application of soil removal procedures.

Concentrated Cleaner—Any cleaner or material at full strength, normally requiring dilution for use.

Concrete Floor—Also known as a Hard Floor. Concrete is a mixture of cement, sand and crushed stone or gravel and water. It sets as a solid mass due to the chemical reaction of the cement with water.

Concrete Seal—Protective coating applied to new or old concrete floor to harden, seal and reduce dusting.

Counter Brush—Brush of horsehair or fibers with extended hand grip of hardwood; used for sweeping in corners, hard-to-reach areas and for sweeping collected soil and debris into dust pan.

Curing—Total period of time for complete setting of floor finishes. From 24 to 48 hours may be required for total cure. Buffing may speed curing time.

Detergents—Cleansing agents designed to reduce the work requirement. Detergents are synthesized chemically from a variety of raw materials derived from petroleum, fatty acids and other sources, available in granular and liquid form, and in pre-measured tablets and packets.

The multiple uses of detergents include wetting, penetrating, dispersing, emulsifying and suspending soil, making it removable by rinsing.

Disinfectant—Chemical which destroys vegetative forms of microorganisms, but not necessarily bacterial spores.

Dry Mopping—Procedure by which a floor is cleaned with a dry mop treated with a dust controllant.

Drying Time—Time required for drying of a coating applied to a floor.

Dusting—Surface cleaning operation to remove light soil. If a treated cloth is used, procedure is normally called dry dusting. If cloth moistened with water is used, it is normally called damp dusting. Also, as applied to a concrete floor surface, dusting means the forming of fine dry particles of the concrete mixture because of foot traffic. Usually occurs due to improper curing or maintenance.

Fast Floors—Floor surfaces that are slippery and may not meet the standard coefficient for slip-resistance as recognized by Underwriters Laboratory.

Feather-in—To carefully blend a spot in with the surrounding area. For example, in the spot touch-up of floor polishes, the newly applied polish is "feathered-in" to the adjacent area.

Finish—Protective coating used on resilient, concrete and wood floors.

Fixture—Furniture or equipment that is not movable; for example, a plumbing unit such as a stool, urinal or lavatory.

Flash Point—Lowest temperature at which a combustible liquid will give off a flammable vapor which will burn momentarily when exposed to open flame.

Floor Brush (Broom)—Used for general sweeping of floors. Also called a Push Broom.

Floor Machine—Power-driven machine equipped with scrubbing or polishing brushes (in sizes 12 inches to 30 inches), used to remove soil by

Floor Types and Covering Materials

Asphalt Tile—Asbestos fibers, mineral coloring pigments and inert fillers bound together with a binder. Tiles are set in cement to form the floor.

Concrete Floor—Mixture of cement with sand and crushed stone or gravel. Mixture sets as a solid mass due to chemical reaction with water.

Cork Floor—Cork comes from the outer bark of the cork oak tree, which is converted into shavings, cleaned and ground. The natural resins in the cork, or added resins, bind the mass together when heat cured under hydraulic pressure.

Hardwood Floor—Wood floors made from maple, oak, beech or various other hardwoods.

Linoleum—Resilient floor covering available in sheet or tile form in many designs. Made from a compound of oxidized linseed oil, finely ground cork, wood flour, color pigment, mineral flours, and resinous binders, bonded to burlap or felt.

Marble Floor—Marble is principally calcium carbonate in crystalline form. Also known as a hard floor.

Rubber Floor—Rubber floors are made chiefly of synthetic rubber, fillers and mineral pigments. They vary widely in form and properties and are available in tiles and sheets, in many degrees of hardness and flexibility.

Terrazzo—Non-resilient floor of marble chips set in Portland cement material or latex, epoxy or other binders and ground to a uniform finish. Also known as a hard floor.

Vinyl Floor—Vinyl resins are used as the binding agent in vinyl flooring. They are tough, chemically inert, insoluble, colorless, odoriess and thermo-plastic. Also called a resilient floor.

Vinyl Composition Tile—Comparable to asphalt tile, except that vinyl-type resins are the binder instead of asphalt or other resins. As with asphalt tile flooring, pigments and inert fillers are used. Also called a soft floor.

Wood Floors—Wood floors may be either softwoods or hardwoods in a variety of widths, thicknesses and designs. Strip flooring is generally affixed to a wooden sub-floor with nails, while the square block-type is generally laid directly in mastic on top of the sub-floor, often a concrete slab. Wood flooring, when properly manufactured and maintained, combines beauty and warmth with long-wearing characteristics. Undue changes in moisture content can cause the flooring to warp and buckle.

scrubbing and for polishing floor surfaces.

Germicidal Cleaner—Cleaner that also destroys bacteria.

Gloss (Initial or Buffed)—Brightness or luster. *Initial gloss* is the gloss of a floor finish immediately upon drying. If the finish is buffed, it is called a *buffed gloss.*

Grain Hardness—One grain of water hardness equals 17 ppm of calcium carbonate. Water in the United States ranges from less than one grain hardness to as high as 50 grains.

Grout—Concrete with small aggregates and heavy liquid consistency, capable of being poured to fill small spaces.

Grouting—Concrete binder used to install ceramic tile, bricks, etc. Also refers to space filled with grout.

Hard Water—Water that contains any amount of chemical compound which interferes with the ability of soap to form a lather. Compounds usually found are calcium and magnesium salts with small amounts of iron and aluminum. The amount of hardness is reported either as parts per million (342 ppm) or grains per gallon. To convert ppm to grains per gallon, divide ppm by 17.1.

Heavily Obstructed—Degree of obstruction to cleaning operations when 50 percent or more of the gross floor area is occupied by furniture or equipment.

Heavy Mopping—A floor cleaning operation using two or more mops and a concentrated solution of cleansing agent. Cleaning solution is applied and picked up from floor area, which is thoroughly rinsed.

Heeling—Method of exerting pressure on a floor machine to remove rubber heel marks or heavily soiled areas.

Horizontal Dusting—Dusting operation performed on surfaces which are horizontal or at no more than 45 degrees from level.

Interior Windows—Windows which are entirely inside a building.

Johnny Mop—Yard mop on a plastic or wood handle approximately 14 inches long, used for cleaning inside toilet stools and urinals. Also called Acrilan Swab.

Lay-Down and Pickup—Terms used for a wet mopping operation with the following sequence: Place mop in bucket and saturate completely. Place mop in wringer, and let excess run off but do not squeeze. Pull 3/4 of mop from wringer and squeeze only the end of the mop. Lay-down solution on floor, then return mop to bucket, rinse, wring dry and pickup solution.

Leveling—The property of a floor polish which causes it to flow together and form a smooth surface after it is spread. Brush or applicator marks represent "hills and valleys" and will level out or become uniform in height if the polish levels well. The term also is used to describe how an emulsion, wax or finish adheres to a floor surface.

Light Cleaning—Cleaning operation sufficient only to remove surface soil.

Limited Sweeping—Sweeping of all easily reached floor surfaces.

Liquid Toilet Soap—A true soap made of pure vegetable oil and potash, with or without glycol or alcohol, free from objectionable odor, and forming a satisfactory lather.

Loose Mop—A wet mop partially wrung out so that about 25 percent of the water remains.

Low Sudsing—Describes a product which cleans without forming foam, and which has low surface tension in water but destabilizes air-liquid interactions and promotes collapse of foam.

Luster—Describes the ability of a surface to reflect natural or artificial light.

Machine-Scrub—To scrub floor surface with manually operated machine.

Machine-Scrub: Automatic—To clean floors using an automatic machine equipped with either bristle brushes or abrasive pads that apply friction to the surface where solution has been deposited, then pick up spent solution, soil and finish and rinse if necessary.

Maintenance—The routine recurring work required to keep a facility in such a condition that it may be continuously used, at its full capacity and efficiency, for its intended purpose.

Management—Those who have prime authority and responsibility to plan, organize, coordinate and control industrial or institutional activities.

Man-Hour—A unit of work measurement equivalent to the productivity of one worker, working at a normal pace for one hour.

Mass Relamping—Replacement of all incandescent or fluorescent lamps in the general-lighting fixtures of a specific area on a scheduled frequency based on average lamp life.

Match Maintenance—A phrase coined to describe a process whereby professional custodial managers work with professional custodians to achieve the best balance between supplies, equipment, time and service. Another aspect is the installment of low maintenance facilities

to reduce maintenance costs.

Mechanical Cleaning—Removing of soil or dirt from a surface by manual scrubbing or use of abrasives as opposed to chemical cleaning. Also, use of machines for scrubbing or cleaning.

Method—A general or established way or order of performing a procedure. The means or manner by which a procedure is presented or taught. Also, the general term used to cover a worker's motion or procedure pattern.

Methodology—Body of methods and rules employed by a discipline. A particular procedure or set of procedures.

Mild Cleaner—Cleaner which is mild or nondamaging in its action on the soiled surface, although it may have a pH of 9.8 or 10. A free alkali of .02 and a pH of 10.4 is still a relatively mild detergent, for example.

Mopping, Damp—Mopping with a mop wrung out in clear water or a diluted detergent solution.

Mopping, Dry—See Dry Mopping.

Mopping, Wet—Use of cotton yarn or synthetic mops dipped into solution which is applied freely to surface. Spent solution and soil are picked up with wrung out mop and surface is rinsed with clear water.

Mop Treatment—Type of dust controllant used to treat yarn or cloth dusting tools. Also refers to the procedure used to treat mops for the purpose of dust and soil adherence.

Multifold Towels—Square or rectangular towels with two or more principal folds dividing towel in at least three equal parts, to be dispensed through towel dispensers.

Neutral—Neither acid nor [illegible] alkali. A neutral soap contains no free alkali or free fatty acids. A neutral pH is 7. In general terms, a neutral soapless detergent has no harsh alkalis though it may have a pH as high as 10 (see pH).

Neutral Cleaner—A solution with a pH of 6.5 to 7.5.

Neutral Detergent—Concentrated detergent with a pH range of 6.5 to 7.5.

Neutralize—To destroy the peculiar properties or effect of; for example, to neutralize an acid with a base.

Neutral Soap—Soap not superfatted nor containing excess alkali. Its pH in water is about 9.5 to 10.0. The term "neutral" is used because an alcohol solution of soap has a pH of 7.0.

Normal Time—Time required by a qualified worker, working at an ordinary pace, when capably supervised, to complete an element, cycle or operation following a prescribed method. The time required by an average worker to perform a task, under average working conditions, at a normal pace. Allowances are not included. See Standard Time.

Obstructed—A condition resulting when 10 to 50 percent of the gross floor area is occupied by furniture or equipment.

Odor Counteractant—An agent which neutralizes the intensity of odor by introducing specific chemical substances, or combinations, into the odorous environment without creating a new odor sensation of equal or higher intensity.

Output—The end result of a mental or physical procedure or process, or the amount of production from the application of work.

Penetration—The ability of a detergent to force its way between particles of soil and between the soil and the surface to which it adheres. This action depends upon surface tension and interfacial tension.

pH—A chemical scale for measuring the alkalinity of a solution. An indication of the strength, rather than the amount, of alkali or acid present. The portion of the scale commonly encountered is from 0 to 14. Boiled distilled water, which is considered neutral, has a pH of 7.0 at room temperature; therefore, 7.0 is neutral on this scale. Acids have pH's lower than 7.0, while alkalies have pH's above 7.0. The lower the number, the greater the acidity; the higher the number, the greater the alkalinity. Following is a table showing the approximate pH value and relative acidity or alkalinity of various compounds in terms of pure water.

Material	Approximate pH value	Relative Acidity or Alkalinity in Terms of Pure Water
Acid		
1% Muriatic Acid	0	10,000,000
1% Oxalic Acid	1	1,000,000
Vinegar	3	10,000
Soft drinks	4	1,000
1% Boric Acid	5	100
Cow's Milk	6	10
Neutral		
Chemically Pure Water	7	1
Alkaline		
1% Sodium Bicarbonate	8	10
1% Borax	9	100
Neutral Liquid Soap	10	1,000
1% Ammonia	11	10,000
1% Trisodium Phosphate	12	100,000
1/2% Caustic Soda	13	1,000,000
4% Caustic Soda	14	10,000,000

Pickup—Emptying waste containers and removing general debris from floor.

Pitting—Small holes that form in hard surface

flooring. Concrete and terrazzo when installed have fine pores, and use of high pH cleaners will cause the holes to become noticeable pits. Sealing such floors and using liquid, low pH detergents will eliminate pitting.

Planning—Advance organizing of projects, projecting schedules, and coordinating operations.

Policing—Making an area clean and orderly; for example, picking up debris and litter from floors, furniture and grounds.

Policy—A guide for those in an organization who are expected to use discretionary judgment.

Porous—Full of tiny openings, usually visible only under a microscope. Porous material, such as concrete, is capable of being permeated by liquids or absorbing moisture.

Poultice—Mixture of a powder and liquid in a pastelike form for application to a surface to remove soil and stains.

Powdering—Undesirable property of a floor finish that causes it to break up into dust or powder. Also the development of a fine white flaky deposit resulting from abrasion of the surface by buffing or heavy traffic.

ppm—Parts per million. Used as a measurement to determine the amount of any substance in proportion to the amount of water or other substance in which it is found. X ppm means X parts in a million parts.

ppm Hardness—Water hardness is expressed as parts per million (ppm) of calcium carbondate or in grains of calcium carbonate ($CaCO_3$).

Precipitation—Formation of solid particles in a solution, or the settling or rising up of small particles in a liquid medium.

Precoating/Undercoating—Application of a seal to a freshly scrubbed surface, free of floor finish, applied to close the pores of the floor prior to applying the finishing coat.

Pretreated—Refers to cleaning cloths, dust mops or similar items that are treated by the manufacturer or supplier prior to delivery to the customer.

Preventive Maintenance—Performance of maintenance procedures and techniques to reduce or eliminate maintenance problems before they arise.

Procedure—Manner of proceeding or acting; also an act or a special course of action. In this manual, used to mean a specific job or task.

Project Cleaning—Cleaning tasks which require special control because of varying frequency; for example, repainting.

Radiator Brush—Single row of horsehair tufts attached to a flat wood handle, used for cleaning radiators, window sills, under furnishings, and other hard-to-reach areas.

Recoatability—Application characteristics of a surface coating and its appearance after successive applications.

Refinishing—Removal of soil and reapplication of a floor finish.

Removability—Ability of a polish to be removed from a test panel by a standard cleaning solution. If finish is not completely removed, polish fails the removability test. "Passing" means the finish can easily be removed from a floor by the usual wax removal procedures with products which are not potentially harmful to the flooring.

Repairability—In floor maintenance, the property which allows a finish to be repaired by the feathering-in and adding of more finish to a damaged spot and use of buffing or other methods to bring repaired spot and surrounding areas to the same appearance.

Residual—Having long-lasting after-effects. For example, when a germicide or insecticide is used and the effects remain several days or longer, they are said to be residual.

Resilient, soft—Type of floor covering, i.e. vinyl tile, as opposed to hard surface flooring, i.e., cement or terrazzo. Resilient flooring is capable of withstanding shock without permanent deformation or rupture. Includes asphalt, linoleum, rubber, vinyl, cork.

Restroom Fixtures—Term used to describe towel dispensers, mirrors, plumbing units, trash receptacles, and so forth, installed in restrooms.

Rinse—Act of applying then removing clean water from a surface in order to remove residual detergent and loosened soil.

Rug—Soft floor covering laid on the floor but not fastened to it. Usually a rug, unlike carpeting, does not cover the entire floor surface.

Scheduling—Preparing written guides to the sequence and frequency of maintenance tasks.

Scrub—To clean thoroughly a surface without removing the finish or protective coating.

Scuffing—Dull marks on a floor where the protective coating has been worn by traffic.

Scrub—To rub hard with a wet, rough brush.

Seal—Substance that penetrates the floor material and fills pores rather than producing a surface finish.

Security—An element of the maintenance of the work environment, intended to protect property, prevent fire or theft, and to detect and report

any malfunction.

Sediment—Fine soil particles in a liquid. With time, the larger of these will settle to the bottom of the container.

Setup Time—Time required to assemble and arrange tools, apparatus, and supplies required for the performance of assigned tasks.

Shelf Life—Period of time a material will remain in its container unchanged after packaging.

Slip Resistance—The "drag" encountered when walking on a floor. The higher the friction, the greater will be the slip resistance.

Soap—Cleansing agent usually produced by the action of alkali on fat or fatty acids, such as olive oil, palm oil or corn oil. There are two general classifications of soap: toilet soaps, pure soaps with no added alkaline builder; and laundry or built soaps, mixtures of soap with extra alkaline salts and other chemicals to increase washing efficiency.

Soil Retardant—Ability of a surface to resist soiling; may be increased by treating surface with a soil-retardant chemical.

Soil—Any material that makes a surface dirty or causes a stain, smudge or spot. Soils may be naturally-occurring or may be made up to various specifications for soil-removal or detergent test purposes.

Solvent Cleaners—Sometimes called emulsion cleaners, these materials are manufactured from hydrocarbons, emulsifiers and wetting agents. They include many stronger basic solvent chemicals such as carbon tetrachloride, trichlorethane, trichlorethylene, methylene chloride and kerosene. Solvent cleaners are used widely, both for general degreasing and a number of specific purposes, such as cleaning commercial garage floors and airport ramps stained by lubricants.

Solvent Finish—Finish made of waxes, resins, or plastics dissolved or dispersed in one or more solvents.

Spalling—The cracking, breaking or splintering of materials, usually at the surface such as on concrete or terrazzo.

Specialized Cleaners—Products manufactured for specific usages. These include rug shampoos; sanitizing and germicidal cleaners for plastic surfaces; lemon oil washes for bronze and stainless steel; specially buffered phosphoric acid washes for aluminum; fungicides.

Specifications—Written performance requirements or quality criteria which may be applied to evaluate or measure goods, materials and services.

Spot Cleaning—Removal of soil from limited areas of walls, carpet or flooring, rather than cleaning the entire area; selective cleaning of small areas.

Spot Relamping—Replacement of burned-out incandescent or fluorescent lamps in lighting fixtures on an individual basis.

Spot Relamping—Replacement of burned-out in- on a noticeably soiled area of floor surface; picking up of litter.

Spotting—Removal of light soil and finger marks from doors, walls, glass, etc. Identifying soil on a surface and removing it by spot cleaning.

Spray Buffing—Restoring a floor surface finish by applying with a spray apparatus a compatible finish and then buffing with a floor machine.

Spraying—Method of applying a chemical to a surface by means of a spray apparatus—a spray bottle or specially designed dispensing nozzle designed to emit a fine mist.

Spreading—See Leveling.

Spreadability—Desirable trait in a floor finish that enables it to cover a floor easily without excessive mopping, streaking, puddling, foaming, etc.

Squeeze Mop—Type of mop that is self-wringing such as a sponge mop with a butterfly closure or mechanism for removing water.

Stains—Soils, usually resulting from spillage or other accidents, that are damaging unless removed by appropriate means. May be caused by a wide variety of substances, such as alcohol, coffee, tea, soft drinks, blood, ink, urine, fruits and fruit juices. Discoloration by any foreign matter.

Stain Removal—Application of a suitable chemical or cleaning process applied after a stain has been properly identified.

Standard—Guide by which to measure quantity, quality, weight, extent, value or performance.

Standard Time—Observed time for performance of a task, adjusted to the normal pace with allowances added for personal needs, fatigue and unavoidable delays. See Normal Time.

Standard Data—Compilation of all the elements that are used for performing a given class of work with normal time values for each element.

Static—Accumulation of electrical charge on a surface, often caused by rubbing two dissimilar materials together.

Steam Cleaners—Cleaners designed to be used

with steam from a jenny or other source to remove soil. Cleaners may be mixed with water in the dilution required and converted to steam and sprayed on the soil. A more concentrated solution may be made and hydraulically added to the steam stream.

Strip—To remove all finish and soil from a surface by use of chemical cleaners and power equipment in order to expose the original surface material.

Stripper—Chemical which removes, peels, loosens or blisters paint, varnishes, seals or other coating.

Stripping—Removal of floor polishes and waxes by scrubbing with a detergent or stripper prior to recoating.

Supervision—Direct and immediate responsibility and authority for accomplishing a program of production or service.

Supervisor—One who supervises or is responsible for labor or a production operation.

Sweeping—To remove soil from floors by vigorous and continuous brushing with a broom or brush.

Sweeping Compound—Usually composed of sawdust treated with a wax or emulsion for dust retention.

Swirl Marks—Marks left on a waxed surface by the buffing brush during the buffing operation.

Synthetic—Substance produced by a combination of elements or simpler chemical compounds, such as synthetic (soapless) detergents, synthetic waxes, plastics and polymers.

Synthetic Coatings—Man-made protective floor primers, polishes and waxes.

Tackiness—Property of being sticky or adhesive. A floor coating may be tacky for a few hours or remain permanently tacky.

Tack Rag—Cloth moistened with a liquid to remove dust and lint from a surface before coating is applied.

Task—Assigned work item.

Tight Mop—Wet floor mop squeezed extremely tight so that there is little water remaining.

Toilet Bowl Cleaners—Special chemical formulations designed to remove hard water film, iron-based stains, organic matter, and germs from vitreous china toilet bowls.

Touch-up—To improve, as in a picture, by touches of a brush or other applicator. Refers also to small applications of wax in spots within a larger waxed surface. To repair worn spots.

Traffic Lane—Area or line of accelerated floor wear due to heavier foot and equipment traffic.

Trainee—Person in the process of being instructed in the performance of one or more tasks or routines. One who undergoes training.

Training—Imparting of knowledge with the specific purpose of developing certain skills and the ability to perform certain functions or tasks.

Treated Dust Mop—String mop attached to a canvas cover and treated with an absorbent emulsion for dust retention.

Unobstructed Area—Degree of obstruction to cleaning operations when less than 10 percent of the gross floor area is occupied by furniture or equipment.

Use Dilution—The ratio of product to water in ready-to-use solution. For example, use dilution of 1 to 64 for a general-purpose cleaner would be 1 part cleaner to 64 parts of water.

Vacuum—Machine capable of picking up soil (fluid soil by special design) by suction, depositing and retaining the material in a self-contained and cleanable hopper, and expelling soil-free air. Also, to clean or dry a surface by means of a vacuum machine.

Vertical Dusting—Dusting operation performed on surfaces at more than 45 degrees from true horizontal.

Wall Washing—Removal of soil from a wall surface with a wall washing machine or by hand with a cleaning cloth or sponge and a suitable detergent.

Waste Removal—Routine custodial operation involving the emptying of waste receptacles, picking up paper and trash and emptying ash trays.

Water Emulsion Finishes—Floor finishes made by mixing the ingredients with water and an emulsifying agent which suspends the tiny silica particles added to prevent slipping. Ammonia or an ammonia derivative is often used as part of the emulsifying agent. Water emulsion finishes are also known as self-polishing because they have a shiny surface without buffing.

Water Resistance—The ability of a floor finish to be unaffected by water spilled on it. A water-resistant finish may show a mark while wet but will recover its original appearance when dry.

Wax Stripper—Special detergent composition which, when used as directed, will remove wax and similar floor finishes.

Wear Resistance—Used in reference to appearance of a floor polish after a specific number of hours of traffic.

Wet Cleaning—Removal of soil from a surface by use of water and some form of detergent material.

Wet Mop—String mop made of cotton or other yarn strand with a canvas band stitched to hold strands together.

Wet Mopping—Cleaning operation in which a solution of water and cleaning compound is spread on the floor by a mop, allowed to stand, then picked up by mop or wet vacuum machine.

Wet Vacuum—Vacuum cleaner designed to pick up water and wet soil from a floor, trapping the liquid out of the air stream by passing it through a tank on the suction line.

Wetting Agent—Substance that reduces surface tension in a liquid so as to permit run-off; also, to cause mixing of solids in a liquid or spreading of liquid on a surface.

Wiping—Cleaning or drying a surface by rubbing with a cloth or other soft and absorbent material.

Work Sampling—Statistical method of analyzing work by taking a large number of observations at random intervals for the purpose of establishing standards and improving methods.

Wringer—Part of a mopping unit used to remove excess water and solution from a mop.

12/Maintaining Synthetic Counter Tops and Table Tops

Counter tops and table tops constructed of man-made materials present a special problem for the maintenance staff. Although modern synthetic materials are highly resistant to spills, counters and table tops located in science rooms may be subject to chemicals that can penetrate. Moreover, tops subjected to abrasive cleaners lose their surface resistance and readily absorb stains.

Spills

Counters and table tops in regular use must be continually inspected for spills that might penetrate the surface if left unattended.

- Chemical or acid spills call for extreme caution. See Procedure 3 in Chapter 9.
- Safe spills should be cleaned up immediately with a cellulose sponge and warm sudsy water. Rinse with clean cold water.

Stains

Stains may be removed with a normal strength all-purpose cleaner followed by a clean cold water wash and rinse. If the stain has set and an abrasive cleaner must be used, the surface lacquer may be damaged and require refinishing.

Inspection

Synthetic tops should be inspected at intervals of no more than 200 hours of service. Look for deterioration of the vinyl lacquer seal coat. When the seal coat breaks down, the surface must be refinished or normal spills will produce penetrating stains.

Waxing

Synthetic surfaces should be paste waxed at intervals of no more than 36 hours of normal service. The wax will help protect the surface against spills and stains.

Refinishing

Refinishing becomes necessary when the vinyl lacquer seal coat breaks down from chemical spills, cleaning with abrasive cleansers, or just day-to-day wear without regular waxing. It usually is necessary to refinish an entire top in order to produce a uniform appearance.

1) Begin by washing and rinsing the entire surface.

2) To remove whatever lacquer remains, clean the surface with a cloth soaked with Methyl Ethyl Ketone. **Caution:** Methyl Ethyl Ketone is flammable and must be used carefully and with stepped-up ventilation. Dispose of the soaked cloth according to safe procedures.

3) In removing the residual lacquer, use a clean cloth to wipe away softened lacquer and excess cleaner.

4) Use abrasive cleansers to remove stains that have penetrated.

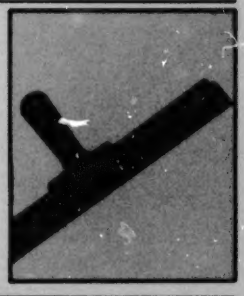
5) Stains that will not respond to cleanser may require sanding. Use an orbital sander with 100 to 120 grit silicon carbide paper. Sand the entire surface unless the operator is skilled at feathering out to the unsanded surfaces.

6) Be sure the surface is completely free of abrasive grit or dust.

7) Coat the surface with vinyl lacquer. The lacquer should be applied at a room temperature of no less than 65 degrees F. Wait at least 24 hours and apply a second coat.

8) When the final coat of lacquer is completely dry, apply paste wax.

Section Three
MAINTAINING THE BUILDING



13/Exterior Building Care 104

14/Roofing Care 105
Built-Up Roofs • Single-Ply Roofs

13/Exterior Building Care

Timely cleaning and repair of exterior building surfaces and components extend useful building life. As in maintaining all physical plant property, careful scheduling and record keeping are necessary to keep buildings looking well-kept and to avoid damaging deterioration by correcting small problems before they become large ones.

Develop check lists for each building to guide inspection procedures. The aim should be to find and record visible defects and to repair them as promptly as possible.

A work schedule should be developed to aid in scheduling and assigning jobs and should be coordinated with the Annual Building Inspection Checklist provided in the Management Tools Appendix.

Following is a typical schedule for exterior building maintenance that should be satisfactory in most instances. Note that this schedule probably should be coordinated with a grounds maintenance schedule (see Section Four—Grounds Maintenance).

Daily

Raise and lower flag.

Weekly

Sweep walks, drives, and parking areas.
Collect litter at building entries, around planters, and on lawns.
Wash door glass and side lights.

Monthly

Wash windows.
Wash aluminum entrance doors.
Inspect building exterior.

Quarterly

Adjust door hardware.
Lubricate door hinges and locks.
Inspect roofing.
Inspect landscaping.

Annually

Lubricate window hinges.
Inspect sidewalks (in late spring).

As needed

Replace light bulbs.
Repaint wood trim and sheet metal.
Caulk sash and door frames.
Repaint metal doors and frames.
Remove snow and ice.
Remove debris at storm inlets.
Tuck masonry cracks. (Consider clear silicone sealant for persistent cracks caused by expansion and contraction.)

Personnel assigned to exterior building maintenance should be experienced in at least minor maintenance tasks, such as tuckpointing, painting, caulking, and carpentry. Major repair tasks may be more beneficially handled by outside contractors. Inspection and other nonemergency types of work can be scheduled during student vacations and/or holidays.

While some tasks must be repeated regularly, others need be accomplished only as they become necessary, such as repainting of wood and metal surfaces and caulking. Necessity for such tasks can be determined during quarterly or annual inspections or based upon a predetermined cycle (such as arbitrarily repainting wood trim every three or four years or recaulking sash and door frames every five years).

Inspectors of exterior and interior surfaces should be alert to insect infestation. Termites can severely damage untreated wood sills, casework, doors, windows, and trim in a very short time and can attack the building even before completion. If treatment of earth at the building perimeter is not part of the building construction contract, then earth and exposed wood surfaces near grade should be treated by the maintenance staff or contract exterminator as soon as possible after occupancy.

14/Roofing Care

Built-up Roofs

Built-up roofing consists of several layers of roofing felt bonded together with bitumen and overlaid with a flood coat of bitumen into which protective gravel is embedded. Some lightweight roofs, steep roofs and roofs of irregular shape have a glazing coat of steep asphalt without gravel. The bitumen may be either coal tar pitch or asphalt. The roofing felt is an organic or mineral material impregnated with coal tar or asphalt.

Hence, there are three basic types of built-up roofs:

1) Coal tar (felt and bitumen) with gravel overlay;
2) Asphalt (felt and bitumen) with gravel overlay;
3) Asphalt (felt and bitumen) with a glazed asphalt finish.

A few roofs use a finish of heavy asphaltic felt with factory-applied mineral granules.

CHARACTERISTICS

Built-up roofs have a tendency to shrink. As the coal tar or asphalt saturants begin to dry out the membranes become brittle, particularly when cold. Drying accelerates when gravel is displaced and the sun can hit directly upon the surface coating. Coal tar systems tend to seal themselves during hot weather. Asphalt systems do not reseal themselves. Surfaces glazed with asphalt are easy to inspect; however, they dry out faster than gravel coated surfaces and must be recoated. Many smooth roof coatings (glazes) become thick; when they shrink, large cracks develop. This condition can be alleviated by painting the smooth asphalt glazed roofs with an asphalt-based, asbestos-fibered aluminum paint. Shrinkage shows up most at gravel stops and wall flashings.

Gravel stop joints are generally located at about 8-foot centers. When the gravel stop is necessarily bonded to a built-up roofing membrane, a crack in the membrane will develop at almost every joint each year. These cracks must be patched at least once (preferably twice) a year with a mastic that is compatible with the roof system (coal tar or asphalt).

Composition flashings which occur at parapets, walls and roof projections usually deteriorate faster than the roofing and sometimes are pulled loose, torn at the corners or pulled apart at the seams. Normally, these flashings extend up the vertical surface about 8 inches to prevent water from leaking into the wall.

Flashings are usually nailed at their tops to the wall and attached to the backing with cement (tar system) or steep asphalt (asphalt system). They are protected at the top with a metal counter flashing. Mineral coated and black colored flashings can be coated with an asbestos-fibered asphalt-based aluminum coating, which will increase their life and make fractures easier to find on subsequent inspections.

Blisters usually result from trapped moisture and are repairable by your roofer. Until they are removed, keep the blisters covered with gravel or reflective surface and do not walk on them in cold weather.

Built-up roofs develop bare spots (gravel washed away) for a number of reasons. If a roofing ply shows through the flood coat or if the flood coat has eroded away, the condition should be inspected by a roofer or architect. Depending on exposure, repair work is usually needed around the tenth year for asphalt systems, about the fifteenth year for coal tar pitch systems, and sooner for glazed coated surfaces. If the flood coat—after scraping with a knife—is at least 1/16" thick, apply a compatible mastic to bare spots and imbed clean

gravel.

Splits in the roofing membrane usually constitute an emergency and require a roofer. Splits in the flashing at gravel stop joints are to be expected. These seldom migrate more than 6 to 8 inches and can be patched with compatible mastic twice a year as routine maintenance.

Identification

If records do not identify the type of roof, obtain a small ball of bitumen from the roof. Make sure it has no gravel in it. Drop it into a container of water saturated with table salt. If it floats, it's tar; if it sinks, it is asphalt.

Most roof specialists agree that tar and asphalt products are not compatible with each other under most conditions and should not be mixed. Accordingly, use coal tar mastic for patching tar systems and asphalt mastic for asphalt systems. Some manufacturers make a coal tar mastic with selected oil additives which they claim is satisfactory with either system.

INSPECTION

Built-up roofs should be carefully inspected at least twice a year, preferably in spring and fall. If maintenance personnel are not experienced in roofing inspection and maintenance, they should seek help from a roofing contractor or other qualified individuals.

Materials required consist of the following:

1) Multiple copies of a small-scale plan drawing of each roof. Each plan drawing should be identified as to the date the roofing was installed and the roofing type (such as built-up asphalt and gravel or tar and gravel).

2) Checklist (see the Annual Building Inspection Checklist in the Management Tools Appendix).

3) Tape measure.

4) Pocket Knife.

5) Camera.

On the drawing of the roof, show locations of flashings, gutters, downspouts, expansion and control joints, parapets, and roof penetrations. Then mark the location of defects on the drawing for reference in planning repairs and specifying work.

At each inspection—spring and fall—report the general condition of each roof, noting visible blisters, ridges, splits, bare spots, and alligator cracking; condition of composition flashings and metal counterflashing; condition of gravel stops, scuppers and drains and pitch pockets. Check for open joints in coping stones and gravel stop flashing splits. Note evidence of ponding. Measure the areas requiring repair. Photograph unusual conditions and date the print.

Drains should be cleaned out and debris removed from the roof before spring rains and after leaves

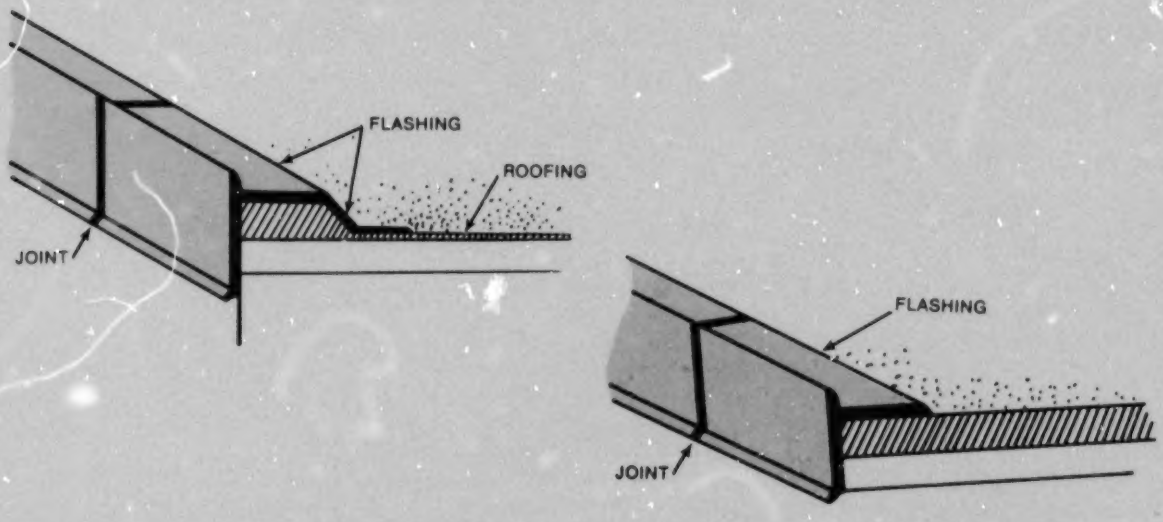


Figure 14-1—Raised gravel stop (left) and flat gravel stop (right) usually require patching once each year at joints and flashing edges.

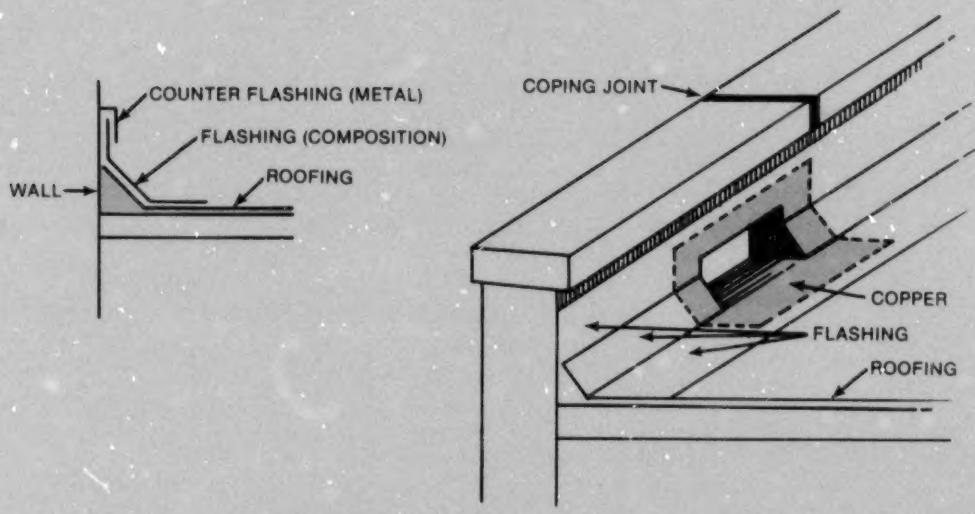


Figure 14-2—A typical wall flashing (left) and typical parapet (right) show locations most likely to need patching, including seams and splits in composition flashing.

have fallen. Plan systematic repair for the summer. Keep a record of roof repairs made, their extent, date and by whom. This record, with inspection reports and dated photographs, can be helpful in diagnosing maintenance problems and anticipating major maintenance.

The maintenance supervisor should be familiar with the details of all roof guarantees and service agreements. He should see that any emergency repairs or maintenance is done in compliance with the guarantor of bond and that required reports are forwarded to the guaranteeing company.

Although an architect should be consulted in planning major roofing work, the school maintenance staff should be able to perform most routine work.

Spring Maintenance

- Remove debris from roof.
- Clean out roof drains, gutters and scuppers.
- Patch gravel stop flashing (see Figure 14-1).
- Re-cover bare spots.

Fall Maintenance

- Remove debris, including leaves.
- Clean drains.
- Patch flashing splits (see Figure 14-2).
- Patch roofing splits. (This is a temporary patch to suffice until roofer can apply permanent patching.)

Safety Considerations

- Use hatchway access to the roof instead of portable ladders whenever possible.
- Wear rubber sole shoes when walking on roofs that have a slope.
- Relegate inspection and maintenance of dangerous locations to those equipped for such work.

Energy Considerations

- Schedule appropriate repair or replacement of wet insulation before the winter season.
- Applying a reflective finish to black roof surfaces will reduce energy usage, improve comfort and increase roof life.

Single-ply Roofs

Typical single-ply roofing consists of one layer of water-impervious material. Although the single-ply roof may be installed by a variety of methods, the most common methods are as follows:

1) Material is secured over the roof deck and/or deck insulation by ballast (approximately 2-inch

layer of rocks).

2) Roofing is attached to the substrate (insulation of former roofing system) by adhesives.

3) Material is mechanically secured by various methods, such as anchor strips or anchor patches. (Nail or screw anchors fashioned with a gusset are secured to the anchor head. Gusset material is, in turn, attached to the underside of the single-ply sheet.) The number of mechanical fasteners is determined by wind conditions.

CHARACTERISTICS

Single-ply systems are manufactured in a multitude of chemical formulas, all exhibiting pliable, rubberlike characteristics. The thickness of the sheet material usually varies from 1/32 to 1/16-inch thick; however, the single-ply materials described as modified bitumen sheet may run around 1/8-inch in thickness.

The materials in single-ply systems display a variety of textures and colors, usually depending upon product chemistry. Some single-ply sheets incorporate a reinforcing mesh, whereas some are manufactured without reinforcement. Also, some materials are surfaced with reflective coatings to deflect solar heat. As the chemistry of these various products differ, so differs the resistance to exposure imposed by environmental conditions prevailing in the area and reaction with substrate chemistry.

Foam Materials

In addition to sheet materials, foam materials (applied by spray-on devices), which usually incorporate silicones or urethanes, are available. Although the industry is not in complete agreement, most spray-on applications are about 1-inch thick. The value of this type of single-ply application depends greatly on the skill of the applicator in the field, the conditions of the substrate, and the climatic environment. Foam systems do not usually call for ballast; however, in some installations aggregates have been used to protect the surface.

REPAIRS

Repair of single-ply systems is as simple as patching a leak in a tire once the location of the leak is identified. Access to the area to be repaired is relatively convenient in either attached ballast-free installations or ballasted system installations. The surface of the ballast-free, attached installation is directly exposed, and the surface of the ballasted system is exposed by pushing aside the unattached ballast material. Once the leak is located, however, application of a patch is subject to a variety of complexities:

1) It is absolutely essential that the exact chemistry of the single-ply sheet system be determined prior to repair. Patch material and application procedures must be compatible with the original material. Some products are adhered at joints, laps, and overlay patches by heat alone, whereas others are adhered by adhesives and sealants formulated especially for the specific product.

2) Some single-ply sheet product manufacturers by pass application contractors and provide their own repair teams to assure repair match-up with the specific single-ply system.

3) If a local roofing contractor is employed to apply patches, it is advisable to require the contractor to submit a letter of certification from the product manufacturer confirming the match-up between the repair patch and the original roofing material.

4) Repair of spray-on (foam) systems requires the services of a specialist.

Beyond these considerations, the repair procedure is simple and usually inexpensive.

Records

It is important that a complete set of records be kept to facilitate future maintenance on a single-ply system. Records should contain the following information:

Base Product Chemistry—including information regarding chemicals and compounds that might deteriorate or shorten the life of the system.

Product Manufacturer—Name, address, telephone number.

Application Date—This date is extremely important because single-ply system manufacturers are continually changing product chemistry to improve their products for various substrate and environmental exposure conditions, or to stay competitive in the marketplace.

Additional Helpful Information—Roofing contractor's name, address, telephone number; guarantees; inspection reports; repair reports.

Even with the relative simplicity of repair maintenance, it is necessary to be sure that any roofing contractor employed to repair a single-ply system is certified by the single-ply system product manufacturer to make repairs.

GENERAL MAINTENANCE

Single-ply systems should be inspected at least twice a year, preferably in the late spring (after

trees have shed seeds and related support growth) and in late fall (after trees have shed leaves). Each inspection should include the following steps:

1) Remove all debris, including leaves.

2) Inspect at corners and around roof equipment for wind dislocation of ballast materials. Carefully replace ballast material over bare areas.

3) Identify the area needing repair (by location and size) in the inspection report and promptly replace the ballast. **Do not leave ballasted systems unballasted overnight.**

4) If leaks have been noted, the roof sheet (if ballasted) should be cleared in suspect areas to locate possible deteriorated material, flashing lap failures, and/or punctures.

Walkways

It is essential that inspections and repairs be made with considerable care on ballasted systems. The turning and twisting of a foot, for example, can cause a ballast rock to puncture the single-ply sheet.

Exercising care in maintenance of rooftop mechanical equipment can become a very important factor in extending the life of single-ply roofing systems. For attached single-ply systems, it is all too likely that equipment maintenance personnel will inadvertantly damage the roof in moving to and from the equipment, by spilling oil around the equipment, or by dropping or setting tools and equipment directly onto the roof. Ballasted single-ply systems are just as subject to all the same causes of damage as attached single-ply systems; moreover, ballasted systems are probably more susceptible to traffic damage than the ballasted systems.

A significant way to reduce roof damage is to provide walkways to rooftop equipment. A walkway can be constructed of thin, precast concrete patio blocks set directly over the single-ply materials with felted separation sheets extending 3 to 4 inches beyond the edges to prevent abrasion to the roofing material. Walkways should also be provided around rooftop equipment as a work surface for maintenance crews.

Inspections

At each inspection, spring and fall, record the general condition of each roof, noting the appearance of surfaces, especially any deterioration indictated by dulling and drying. Many roofs incorporate areas which, because of their protected locations, are shielded from severe environmental elements, particularly sun and atmospheric fallout. These protected areas can be helpful in judging apparent surface deterioration by comparing them with surface materials exposed to severe elements. Another way to judge deterioration is to retain a piece of unexposed surface material from the time the roof was first applied.

Also, be sure to check for deterioration of flashing and splice laps with particular attention to edge sealant deterioration and lap delamination. At each inspection, note the age of the roof as an aid in judging the condition of surfaces, laps, and splices. Noting the age will help anticipate major repairs or replacement for purposes of budget planning.

Section Four
MAINTAINING SCHOOL GROUNDS

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15/Effective Grounds Management

The first step in managing a grounds maintenance program is to identify all necessary tasks and categorize them into seasonal jobs. A variety of circumstances will limit the amount of work that may be finished; thus, it is essential that priorities be established.

The second step is to devise an efficient combination of people and machines.

The third is to develop a schedule that will accomplish the most work in the time available. To eliminate last-minute confusion, work areas should be identified, equipment should be available and in good working condition, and personnel must have a thorough knowledge of job requirements and limits.

For these reasons, preseason preparation cannot be over-emphasized. The following steps will ensure that the best use is made of time and manpower available:

- Repair parts for equipment must be ordered soon after the using season ends.
- Rebuilding of machinery should be well underway at least two months before it will be needed again.
- A judicious inventory of spare parts should be on hand to minimize down time.
- Often, a spare machine is a wise investment that will keep production rolling if a breakdown cannot be repaired immediately.
- It is advisable to keep track of maintenance costs on each type of machine. If repair costs and down time are excessive, consider changing to a different make or model.

A certain amount of hand labor always will be necessary in grounds maintenance. However, increasing labor costs dictate that each supervisor must continue to search for the right piece of equipment for the job. If unsure of what to buy, consult with other supervisors who have similar responsibilities. Most are happy to relate their experiences and will "tell it like it is." Before purchasing, it is usually possible to try out a piece of equipment to learn if it really is capable.

Be sure that everyone responsible understands the importance of preventive maintenance. Adherence to manufacturers recommendations is essential if a machine is to return its cost in service.

A grounds maintenance team must be a well-integrated group of selected individuals, who must possess a wide range of knowledge and skills. In all phases of the grounds operation, safe working conditions, positive attitudes and correct procedures must be constantly emphasized. Few kinds of work present more potential hazards, since equipment and chemicals used are dangerous. But safety can be maintained if each person is properly aware of the responsibility to follow safe practices.

Overcoming Obstacles

Facilities that have been around for a long time

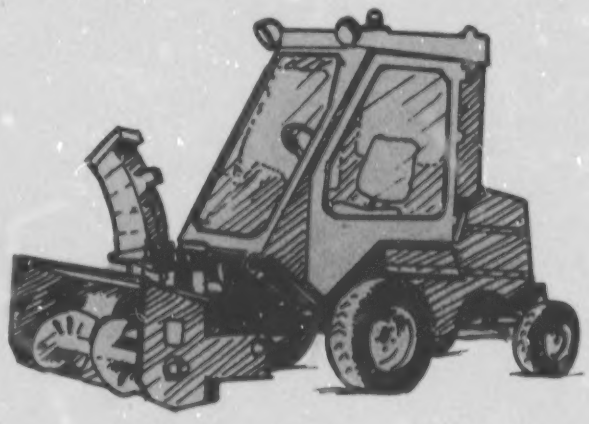


Figure 15-1—Snow blower mounted on a small tractor.

A Suggested Seasonal Schedule

Spring

1) Remove leftover leaves and thoroughly clean up the grounds. Pay particular attention to correcting conditions that damage mowing equipment.

2) When flower beds can be worked and danger of frost is over, plant spring flowers.

3) Fertilize lawns as soil tests and programs dictate needs.

4) Spot repair turf areas with sod. Lay no more sod than can be kept watered in summer dry season.

5) Begin mowing grass and trimming hedge when growth appears. If this activity falls behind schedule, spring weather may not allow work to be caught up.

6) Prune early flowering ornamental shrubs after spring blooming is over.

7) Check all hoses and irrigation equipment. Make needed additions and replacements.

8) Identify damage to streets, parking lots, and sidewalks caused by freezing and thawing or general wear and tear as soon as ground thaws. Prepare or contract summer oil and chip program as needed. Develop possible grounds improvement projects.

Summer

1) Finish broadleaf weed spraying before hot weather arrives.

2) Inspect newly-sodded areas, trees and shrubs regularly. Water when rainfall is inadequate. Don't wait too long to water.

3) Order and schedule delivery for replacement trees for fall and early winter planting.

4) Maintain leaf removal equipment and test-run for proper operation.

5) Improve and maintain streets, parking lots and sidewalks.

6) Hand weed shrub beds and other areas unaffected by control spraying. During dry periods, part of the mowing force can help.

7) Establish new lawn seedings in early August. Irrigate if necessary.

Autumn

1) Control early leaf fall by attaching mulchers to mower during final weeks of mowing season.

2) Repair turf with sod as long as soil conditions permit.

3) Fertilize lawns according to program established.

4) Before storing mowing equipment, analyze replacement and repair needs. Order parts and new equipment.

5) Go over all snow moving equipment and establish route and equipment responsibilities for personnel. Identifiy priorities.

6) Plant spring bulbs before the ground freezes.

Winter

1) Continually inspect and maintain snow moving equipment. Be sure all engine-powered equipment has enough gasoline in tanks to operate four hours before being sent to job sites. (See Figure 15-1. Also see Procedure 12 in Chapter 9.)

2) Establish a protected supply of size-selected sand, equal to one-half the average annual volume used. Replenish as used, as suppliers' stockpiles may freeze and become unavailable.

3) Keep an adequate supply of snow and ice-thawing chemicals on hand.

4) Continue area cleaning and trash pickup when snow is not on the ground.

5) Clean catch basins. Sweep streets and parking lots.

6) Order spring shrub and tree replacements. Arrange for potted spring annuals.

7) Develop or revise lawn care, plant pest and weed control programs for spring and summer. Order needed chemical supplies.

8) Clean and repair all equipment and tools needed for the growing season.

seldom were designed with current maintenance methods in mind. Conditions particularly troublesome are overgrown landscape plantings, narrow or broken sidewalks, paved intersections with inadequate radii and improper lines or grades.

These areas place restrictions on equipment choices and operating techniques. A systematic elimination or rejuvenation of old and unattractive plantings may provide enough open space to allow a large riding mower to be used instead of a small, inefficient hand mower. Another example is a privet hedge that must be trimmed three or four times a season—reduced labor costs would pay for a Japanese yew hedge replacement that needs attention only once a year.

Also, it often is beneficial to make certain physical changes in the landscape or modifications to facilities. For example:

- Bad drainage may be solved by regrading, tiling, or installing french drains or catch basins.
- Reseeding of shade killed grass areas can be eliminated by substitution of the proper mulch.
- Deflectors installed at building exhaust vents will stop killing of plant material.
- Urns and trash containers at entrances will reduce area clean-up needs.
- A ribbon of concrete, asphalt, or gravel installed over plastic will eliminate weeds and growth where car bumpers overhang.

Some points to consider in making changes include:

- Analyze the condition and position of shrubs, trees and other plant material. Eliminate or relocate to create a balance between esthetic considerations and economical maintenance.
- Consider mature plant size when selecting ornamentals.
- Choose plant materials that are vigorous and compatible with all the growth factors at the site.
- Avoid trees and other plants known to be susceptible to insect and disease damage.
- Avoid repetitious planting of the same material (monoculture). This may create an environment where insects and diseases undetected at first can become prevalent, causing high maintenance and replacement costs.

Encouraging Growth

Complete grounds maintenance must include giving trees, shrubs, and lawns a helping hand to maintain their health and vigor. A written record of the kind, number, location and condition of plants provides a basis for several programs designed to combat damage by insects, climate and people. Experts in ornamental horticulture and forestry at state universities are equipped to diagnose problems and recommend remedies.

Comprehensive soil testing is a first step in establishing a sound program. In general, trees and shrubs do not need special attention and can receive needed additional feeding during normal lawn fertilizing. However, it is advisable to help trees surrounded by expanses of concrete or asphalt paving. This urban environment weakens trees, particularly those established before the construction. Under stress, such trees slowly decline, become subject to disease and insect damage, and eventually die.

Flexible Grounds Management

Effective, cost-controlled grounds maintenance is characterized by an attitude of always looking for better ways of doing things. If an accurate diary could be kept over a long period of time, a pattern would be seen of subtle differences in each major activity from year to year. An attempt to treat each year the same as the last, with hard, fast rules will result in decreasing productivity and declining vigor of the landscape.

A suggested seasonal schedule of activities accompanies this section (see page 113). Note that this schedule may need to be coordinated with the building interior maintenance program in many situations, depending on the size of the staff and how the workload is divided.

A Guide to Manpower and Level of Appearance

In maintaining grounds, appearance is a function of manpower and materials—cost, in other words. Until local experience proves otherwise, you can assume that 65 cents of each dollar spent on grounds maintenance goes for labor. The remaining 35 cents goes for equipment and supplies.

Here are three "levels of appearance" and the tasks and manpower required to maintain each level.

1) High standard of appearance will require one worker for every three to five acres to:

- Trim or replace trees as needed.
- Trim or replace shrubs as needed.
- Mow grass as needed.
- Use chemicals as needed.
- Provide sanitation as needed.
- Provide extra services.

2) Medium standard of appearance will require one worker for every five to 15 acres to:

- Trim trees and replace them selectively every one to three years.
- Trim shrubs three to four times a year and selectively replace them every one to three years.
- Mow grass as needed.
- Use chemicals once a year or every two years.
- Provide sanitation weekly.
- Limited extra services.

3) Low standard of appearance will require one worker for every 15 to 25 acres to:

- Seldom trim trees with few replacements.
- Trim shrubs once or twice a year with few replacements.
- Mow grass as infrequently as possible.
- Limited use of chemicals (or none).
- Monthly sanitation.
- No extra services.

16/Tree and Shrub Care

Pruning insures proper growth and form. Caution should be taken to prune trees and shrubs at the proper time of year, using the following guidelines:

1) Use tools that are sharp and clean cutting.
2) Start shaping trees at planting (see Figures 16-1 and 16-4).
3) Diseased, dead or broken branches can be removed at any time.
4) Leave no stubs or ragged cuts.
5) If two branches are rubbing or interfering with each other, causing bark wounds, prune the weaker branch.
6) Always cut back to another branch or bud. If the end of the branch is dead, cut beyond to live, healthy wood.
7) To be sure the branch is dead and not dormant, slice the bark and look for green wood.
8) Prune off one-fourth to one-third of branch growth when planting plants with bare roots.
9) Bark wounds an inch or larger in diameter should be covered with an asphalt base wound dressing.
10) Thin and remove old wood from established shrubs. This produces more flowers and better fruit, and improves vitality of the plant.
11) Trees and shrubs should not obstruct the view from the windows of a building.
12) On all heavy cuts, make removal in three steps as shown in Figure 16-1.

PRUNING HEDGES

In the spring, heavily prune newly planted hedge down to a uniform height. Prune again in the summer after new growth has developed. This will encourage side branching and make a wide-based hedge easier to establish (see Figure 16-2).

PRUNING EVERGREENS

Shrubs: Do not remove lower branches, which should grow and branch to the ground. Do remove dead branches.

Broad-leafed evergreens (Mountain Laurel, Rhododendron, Azaleas, etc.): Do not prune except to remove dead wood. If plants reach an undesirable height, cut nearly to the ground. New growth will form at the base if plant is vigorous.

Narrow-leaf evergreens (Juniper, Arborvitae, Taxus): Prune in spring, removing whole branches. Prune no more than one-fourth of total plant growth. Cuts should be concealed so foliage may hide the branch stubs, leaving the plant in a more natural state.

Narrow-leaf evergreens (Spruce, Fir, Pine): These evergreen are not generally pruned, except when the plant is less than five feet tall, to increase foliage density. (See Figure 16-3.) Shear no more than one or two inches of foliage. Do not expose old wood, which cannot easily be covered because new growth from the wood of the branches is slow.

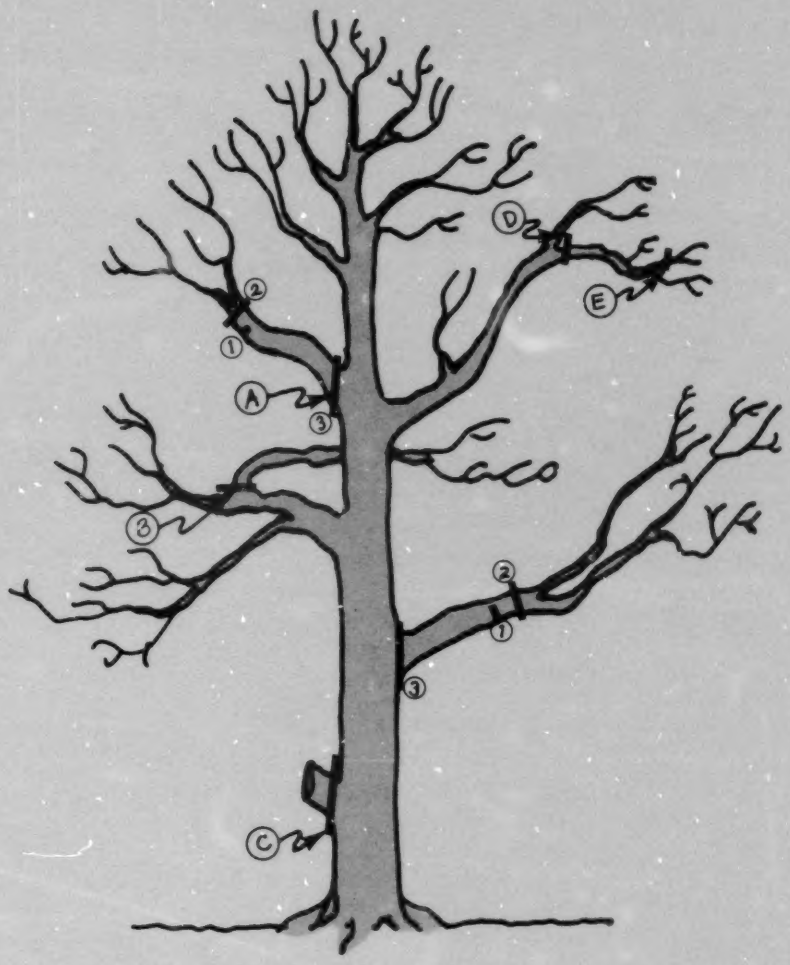
Spring flowering shrubs: Prune after the blooming period. This assures more flowering wood for the next year, because the flowers are borne on the wood from the year before.

Summer flowering plants: These plants that produce flowers on wood of the current year may be pruned in the spring before growth begins. When the plant becomes dormant, fall or winter pruning (after flowering) works well.

PRUNING SHADE TREES

Young shade trees need balance pruning. In the first year, encourage new growth by cutting branches to balance root loss. Limbs can be shortened from one-fourth to one-third. Remove structural deformities.

During the second and third years, remove fast-growing limbs that tend to crowd or compete with the main limbs. See Figure 16-4 for guidance in shaping a shade tree.



On all heavy cuts, make removal in three steps:

(1) Make a partial "undercut."

(2) Remove the limb above the "undercut."

(3) Remove the stub at shoulder rings.

(A) Remove weak crotches.

(B) Remove "cross-over" or interfering branches.

(C) Prune back to side branches, laterals, or main trunk. Cut flush; never leave stubs.

(D) On average high cuts, use a pole saw.

(E) On small high cuts, use pole pruners.

Figure 16-1—Good pruning techniques are essential in keeping diseased, dead, and broken branches removed at all times.

Fully-grown shade trees require little pruning except to remove dead and diseased branches.

PRUNING SHRUBS

Gradual rejuvenation: For plants that have become too large for the space they occupy or so old they are unsightly and do not flower well, see Figure 16-5. To prune, cut the oldest branches off at the ground. Leave the young stems, and gradually remove older wood *over a period of two or three years*. Some multi-stemmed shrubs that benefit

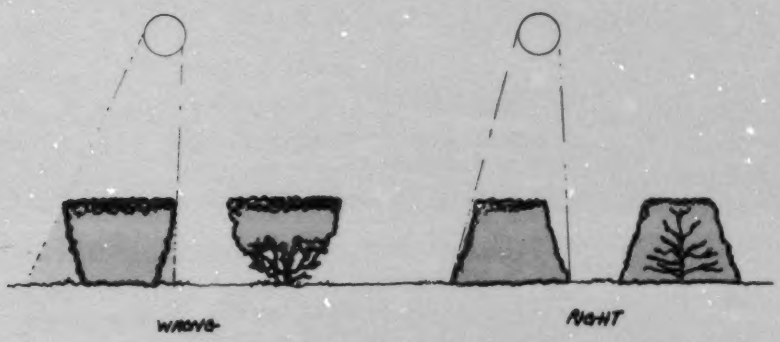


Figure 16-2—Wrong way to trim hedge is shown at left, where overhanging top edges shade the sides. The sides soon lose their leaves and become thin. In the properly trimmed hedge at right, the top is narrower than the base and the sides slope outward. Thus the entire hedge is exposed to sunlight and will grow healthy, compact, and dense.

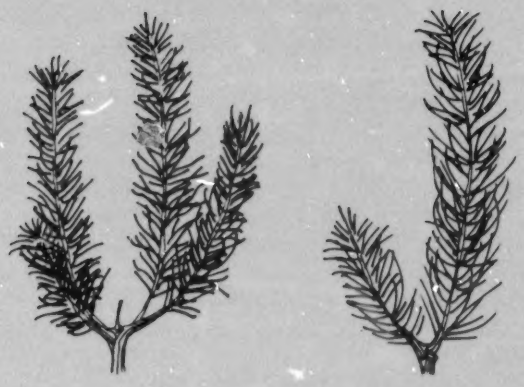


Figure 16-3—Evergreen pruning. The pine on the left shows a lost leader (stub in the crotch). The three one-year-old shoots will compete, probably making a triple-trunked tree. For corrective pruning (right), competing growth has been removed entirely or cut back to half, leaving the strongest, most upright shoot to serve as a leader. Pruning cuts should be sealed. In a few years the trunk will make sufficient secondary growth so the injury will not be noticed. Pines respond best to June pruning.

from this method are lilac, privet forsythia, viburnum, honeysuckle and barberry.

Thinning: For plants that are too dense, see Figure 16-6. Cut off a twig or branch that is attached to the main stem. Remove quick-growing sprouts.

Heading back: The purpose of this pruning method is to reduce the height or size of the plant and encourage development of small shoots and buds. See Figure 16-7. Cut a terminal portion of a branch back to a bud of another branch. This creates more density.

Thinning and heading back methods work well together to keep large plants within bounds. Do not prune the stems and shoots the same height. This gives the plant a "crew cut" appearance and causes excess growth at the top. See Figure 16-8. Thinning helps open the center; heading back controls height.

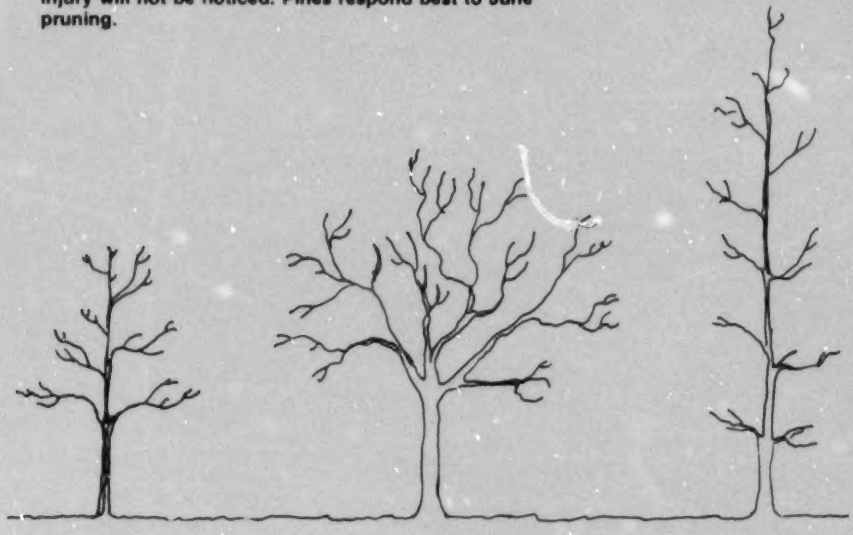


Figure 16-4—Starting with a young shade tree (left) proper trimming determines ultimate shape. For a compact, open spreading tree (center) remove the central leader at the height where the tree is desired to crown out. Side branching also is encouraged by removing terminal buds or pruning twig ends. For an upright growth (right) protect and encourage the central leader and remove the side or lateral growths. To develop a strong trunk, leave low side branches on for a year or two but keep them headed back and remove them as the tree develops.

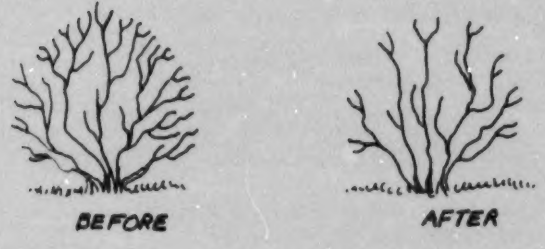


Figure 16-5—To rejuvenate old shrubs, cut the oldest branches off at the ground.

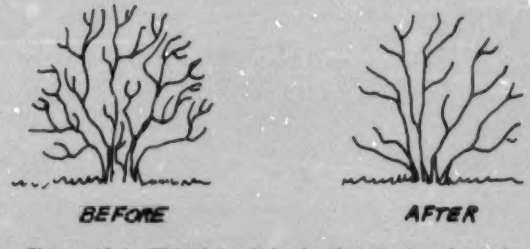


Figure 16-6—Thinning of shrubs that are too dense is done by cutting off twigs and branches where they attached to a main stem.

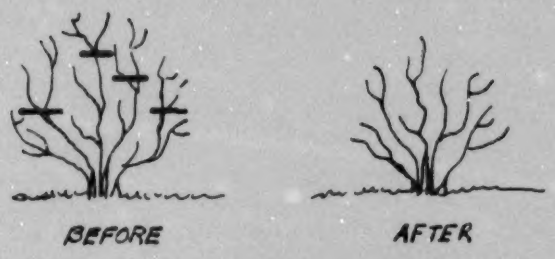


Figure 16-7—Heading back reduces plant size but increases density. Cut the terminal portion of a branch or twig back to a bud or another branch.

ROOT PRUNING

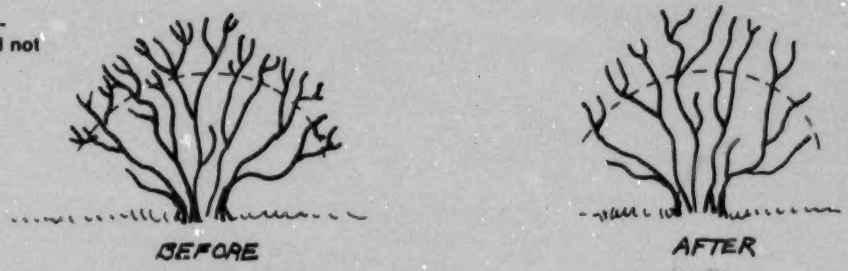
Roots of a plant that is to be transplanted should be pruned one year before the plant is moved. This develops a denser root system with more roots in the ball.

During the summer, after the plant stops growing on top, push a sharp spade to its full depth into the ground around the plant in a circle twelve inches in diameter for every inch of stem diameter.

Water as needed. During the rest of the summer, the plant will fill out the root ball. The following spring, during its dormant stage, the plant is ready to be moved.

Established trees: Exposed surface roots should be severed and dug out of the turf, a few at a time. The severed ends should be painted with tree wound dressing.

Figure 16-8—Poor pruning technique. Stems and shoots should not be pruned at the same height, because this gives the plant "a crew cut" appearance and stimulates excessive growth on the top of the plant.



17/Building a Lawn

The general steps in establishing turfgrass for a good lawn are:

1) Make a complete soil test.
2) Rough grade.
3) Lime, according to test results.
4) Apply basic fertilizer.
5) Apply soil amendments, if needed.
6) Till above materials into soil to a depth of four to six inches.
7) Finish grade.
8) Apply starter fertilizer and work into top surface of soil.
9) Apply seed or lay sod.
10) Rake or drag to cover seed.
11) Roll lightly (for either seed or sod).
12) Mulch to prevent erosion and conserve moisture.
13) Water lightly and frequently.

Soil Testing

The best guide for proper establishment of turfgrass is a complete soil test. The results give pH and lime requirements and show the amount of phosphorus, potassium and organic matter present in the soil. Highly irrigated sites should be tested for soluble salts.

Rough Grading

Remove debris, including stones. Before applying lime or fertilizer, till the soil and rough grade. Where topsoil is to be replaced, rough grade to the contour of finished grade to facilitate all-over distribution of topsoil. Final depth of topsoil should be at least six inches.

Liming

If the lime requirement test shows a need for lime, broadcast and work in the correct amount of ground limestone (as shown by the test) to a depth of four to six inches. Where the test is not available, use at least 100 pounds of ground limestone per 1,000 square feet.

Fertilizing

Basic fertilization: For soil that has been tested, spread the recommended amount of fertilizer and work it in to a depth of four to six inches. For soil that has not had a complete test, use 50 to 75 pounds of 0-20-20 fertilizer or equivalent per 1,000 square feet. Spread and work in to a depth of four to six inches.

Starter fertilization: Before seeding, spread and rake fertilizer into soil about one inch. Use fertilizer with a 3-4-1 ratio in which one-half to three-fourths of the nitrogen is slowly available (20-24-6, 28-20-5). Apply three to four pounds per 1,000 square feet.

Soil Amendments

If the soil shows a lack of organic matter, work in the recommended amount four to six inches before applying starter fertilizer. Recommended sources of organic matter are sphagnum peat, leaf mold or a combination of the two. Well-rotted sawdust or manure may be used.

Finish Grading

To finish grade, rake before seeding or sodding. Light rolling will show any irregularities. A firm profile is required to prevent settling later.

Seeding

See page 122 for a discussion of turfgrass varieties that are best for Illinois. In other states, consult the horticultural department or the grounds manager at a nearby university for guidance in selecting turfgrasses and seeding times.

Late summer to early fall is the best time for seeding permanent turfgrass. Recommended times for

varying conditions in Illinois are:

Southern Illinois—September 1 to October 5
Central Illinois—August 20 to October 1
Northern Illinois—August 10 to September 10

Small disturbed areas should be seeded as soon as possible, regardless of the best seeding time. Where spring seedings are necessary, for best results seed no later than:

Southern Illinois—April 1
Central Illinois—May 7
Northern Illinois—May 30

Sow the seed mixture recommended for the climate in your region and adapted to specific conditions:

Area of heavy shade (less than one-third of day in direct sun): Apply four to five pounds of Creeping Red Fescue or C-26 Hard Fescue per 1,000 square feet. These conditions might exist on the north side of a building.

Area of moderate shade (one-half to two-thirds of day in direct sun—under trees, for example): Sow four pounds of shade-tolerant Kentucky Bluegrass (Nugget, Aquila, etc.) per 1,000 square feet.

Area of little or no shade: Apply four pounds of a good Kentucky Bluegrass (Baron, Victa, Aquila/Parade mix, etc.) per 1,000 square feet.

If the newly-seeded area will be subject to high traffic, a mixture containing the good Kentucky Bluegrass and fine-leafed perennial Ryegrass (Pennfine, Manhattan) should be used at six pounds per 1,000 square feet. The area, once established, should perform well under moderate maintenance programs of fertilization, watering and aerification.

Rake lightly or drag area to cover seed no deeper than one-fourth inch. Roll lightly to firm soil around seed.

Sodding

Check vendor inventory of various sod mixtures. Choose healthy, active sod that is weed-free.

Mulching

Use clean straw or marsh hay. Lightly mulch seeded area (mulch may be left on the area to decompose). Do not cover the area completely, as heavy mulch must be removed after seed germination.

TURFGRASS CARE

Fertilization

Fertilization is an important key to improving poor lawns or maintaining good ones. Grass and green plants need the following:

Nitrogen for growth and good leaf color;
Phosphorus for deep healthy roots;
Potash to promote disease resistance. For many plants, potash also is necessary to the growth process.

Mowing

For a well-groomed appearance and long life, mowing practices are important.

Height of cut: Creeping type plants produce adequate leaf surface at very low cutting. Kentucky Bluegrass and fine leaf fescues should be cut high (1½ to 2½ inches) to assure satisfactory growth. Bunch-type grasses (tall fescue and rye grass) should be cut 1½ to 3 inches.

Frequency of cut: Frequency is determined by the amount of growth. Remove no more than one-third the total height at any one mowing.

Mowing practices: Be sure mowing equipment is in good operating condition. Dull, improperly adjusted equipment damages leaf tips and invites disease organisms. Reel type mowers are recommended for cutting quality turfgrass. Rotary mowers should be used where grass control is more important than appearance. (See Figure 17-1.) Dry grass cuts easier with a rotary mower; therefore avoid mowing wet grass. Cut new grass when it is two inches high. After three cuttings, apply a general weed killer.

Watering Turfgrass

Applying water: Sprinklers should be set for even distribution, allowing the soil to absorb the water. Too large a volume of water in a concen-

Lawn Mowers

Because lawn mowers represent a major investment, it pays to buy only those that meet performance criteria. For example, a mower must have:

1) Exceptional maneuverability of zero to 12-inch turning radius at the cutting head.
2) "Out-front" mowing to eliminate tire streaking.
3) Even distribution of cut grass across the width of the cutting head.
4) Adequate ratio of engine horsepower to cutting width (one horsepower for every four inches of cutting width).
5) Minimum use of V-belts in drive and cutting system.
6) Available with closed cab, lights, chains, snow thrower, broom, and angle dozer for snow removal.

Figure 17-1—A typical riding mower.

trated area causes surface run-off and wastes water.

Amount: Enough water should be applied to thoroughly wet the root zone. The type of soil determines its water-holding capacity. One inch per week, either by rainfall or irrigation, is needed.

Frequency: This depends on type of grass and climate—rainfall, temperature, wind movement and humidity. Irrigate to provide vigor and growth as necessary.

Newly-seeded areas need to be kept moist during germination and until the plants are established. Water lightly and frequently.

Turfgrass that is wilted enough to retain a footprint needs watering. When plants show signs of wilting, water deeply. Shallow watering encourages weak turf.

GROWING TURF IN THE SHADE

Turfgrass may fail under trees because of competition for water, light and nutrients. The following practices may improve turf under trees:

1) Use shade-tolerant grasses, such as Pennlawn Creeping Red Fescue, Chewings Fescue, Alta or Rebel Tall Fescue, Poa Trivialis (rough bluegrass).

2) Fertilize the grass at higher rates than normal.

3) Perform deep watering to prevent tree roots from surfacing.

4) Remove trees that do not add beauty to the landscape or serve a purpose.

5) Prune trees as far as possible without destroying their function or beauty.

6) Prune shallow tree roots.

7) Plant new trees with care. Shade trees should be a minimum of 50 feet apart.

8) Plant trees that present minimum competition to grass (linden, honey locust, bald cyprus).

9) Provide good drainage and aeration.

10) Fall seed the turf. Trees then offer less competition for water, light and nutrients.

11) Shaded grass should be mowed higher than the same grass in the open sun.

12) Control weeds to reduce competition for water, light and nutrients, but *do not use dicamba herbicide.*

Turfgrass varieties for Illinois

Kentucky Bluegrass

This species is widely used and thrives in sunny areas. It tolerates occasional drought and comes back quickly when adequate moisture is provided. Kentucky Bluegrass does not tolerate dense shade; therefore, mixtures of the bluegrass with Creeping Red Fescue should be used for variable light conditions.

Baron, Bristol, Victa and Vantage are the improved varieties of Kentucky Bluegrass used in Illinois for high-level maintenance lawns. Their low growth results in a dense turf and is superior to most varieties of Kentucky Bluegrass in leaf spot tolerance, appearance, vigor, and general turf qualities.

Maintenance: Most Bluegrasses perform well within a 1 1/2 to 2 1/2-inch mowing height. Both Baron and Victa can be cut from 1 1/4 to 2 inches. Generally, 4 pounds of slow-release nitrogen per 1,000 square feet per year is required for a Kentucky Bluegrass lawn.

Dethatching and aerification may be required, especially in areas of high traffic and heavy use.

Ryegrass

Ryegrass is actually a name given to two closely related grasses. Annual Ryegrass germinates in a few days, gives protection for the slower-developing bluegrass and conserves moisture. Perennial Ryegrass such as Pelo, NK-100, or Manhattan, may be mixed with permanent grass at no more than 20 percent of the mixture by weight.

Maintenance: Keep Ryegrass 1 1/2 to 2 inches mowing height. Two pounds of slow-release nitrogen per 1,000 square feet per year should be enough fertilizer.

Tall Fescue

This grass is durable, grows well in sun or light shade, and is used for playgrounds and athletic fields because of its low maintenance requirements. It is not desirable in a fine lawn, because the fescue tends to form large clumps. Once established, Tall Fescue can be removed only by digging out each area by hand or by sod-cutter. Rebel is an improved variety.

Maintenance: To seed Tall Fescue, use 10 to 12 pounds per 1,000 square feet. Mow to a height of two or three inches.

Creeping Red Fescue

This is a rapid germinating grass used in seed blends for moist, shady locations. Because it establishes quickly, it gives protection to slower-germinating varieties such as bluegrass. It gives a fine texture to the turf.

Maintenance: For best turf performance, mow regularly at 1 1/2 to 2 inches. Two pounds of slow-release nitrogen per 1,000 square feet per year are required.

13) Remove leaves and other debris promptly.

14) Use other types of ground cover, such as baltic ivy, periwinkle, or pachysandra.

AERATION OF TURFGRASS AREAS

Compacted soil as thin as one-fourth to one-half inch greatly reduces nutrient penetration, water infiltration, and oxygen and carbon dioxide diffusion.

Mechanical aeration is a means of reducing this serious condition. Aerating machines punch holes in the thatch layer, creating an artificial system of large pores through which moisture and nutrients can enter the soil. The pores also create a breathing system through which carbon dioxide can escape and oxygen can enter the soil.

Spring and early fall, when the desirable grasses are growing vigorously, are the best times to aerate. Aeration reduces plant population, and unless it is done at the proper time, the turf area may take several months to return to an attractive lawn.

Aeration provides several benefits. It increases surface drainage, relieves soil compaction, provides openings for mulch to work in, allows air, water and nutrients to penetrate the soil surface, decreases disease and insect damage, and increases plant density.

Generally, two types of aerators may be used. The aerator with solid spikes must penetrate four to six inches into the ground. The coring-type aerator needs to penetrate only two to four inches, and

removes a soil core. Any penetration less deep is a waste of time.

MOSS IN THE LAWN

Factors that may cause moss in the lawn include low fertility, poor drainage, too much shade, high soil acidity, and soil compaction. Some corrective measures are:

1) Have a regular, balanced fertilizer program.

2) Remove established moss with a rake, "burning" with ammonium sulfate, or spraying with copper sulfate. Apply concentrated amounts of ammonium sulfate directly on moist moss. Do not water into soil. Use five ounces of copper sulfate to four gallons of water per 1,000 square feet.

3) When the moss has been removed, correct the basic cause and follow with good management practices for a dense, vigorous turf.

18/Caring for Bituminous Paving

Generally speaking, butuminous paved surfaces (blacktop) do not wear out. That is, the material itself does not. What it does do is dry out and erode away. However, bituminous paving that is not properly applied, applied on an unsatisfactory base, or exposed to directional friction (heavy vehicle stops) does break down.

The following maintenance suggestions do not address the problem of improperly prepared asphaltic paving. Maintenance will not cause a bad paving job to become good. The primary purpose of maintenance is to retain the quality of a good pavement. The secondary purpose of maintenance is to repair asphalt paving which has not been properly maintained or has suffered spot deterioration.

PREVENTIVE MAINTENANCE

To prevent drying out, it is necessary to coat and recoat the surface as needed to retain plasticity and decrease oxidation from sunlight.

Scheduled Inspections

Parking lots, drives, etc. should be inspected for signs of drying out in late spring or early summer each year. Bituminous paving needing maintenance will appear dull, dry, possibly dusty in surface appearance. Cracking, usually described as alligatoring, may also show up. Such signs mean the paving should be promptly sealed to retain the evaporatives within the product and prevent further deterioration.

Materials and Procedures

There are two basic materials for sealing the surface of blacktop paving.

- Asphaltic base emulsions.
- Coal tar pitch emulsions.

Asphaltic sealer emulsions and coal tar pitch emulsions should not be compared as equivalent products for the same purpose.

Asphaltic emulsion sealers are generally used for drives, bus lanes, and delivery areas and as a base for special sealers for game courts in preparation for color coating. Dilution of factory prepared sealer products, prior to application, should be done strictly in accordance with the recommendations of the manufacturer.

Coal tar pitch emulsions are recommended for areas such as parking lots, combined parking lots - playground areas, and service delivery areas where oil or gasoline may drip from autos and trucks. Coal tar pitch emulsions should not be used as a sealer or filler base where color coats are to be applied.

Application and Conditions

Application is usually by rubber applicator blade. However, application devices range from small, self-powered machines to large commercial machines. The application method, therefore, should be selected according to areas to be sealed, budget and manpower available.

Sealing should be a two-coat application, each providing 100 percent coverage. The application should never be so excesive as to allow puddling on the surface.

Before applying maintenance sealer, the paved area should be cleaned and corrected if necessary to drain free of ponding water. Sealers should be applied under the following conditions:

- The surface should be clear of all foreign and loose materials prior to application;
- Fair weather at minimum 50 degrees F for 48 hours prior to application;
- Fair weather at minimum 50 degrees F forecast for a minimum of 24 hours following application and preferably 48 hours.

Sealers, Fillers and Color Coats

Special products are available to perform as a sealer or sealer-filler and are recommended for application preceding color coat for game courts. Many pre-colorcoat sealer emulsions contain graded sand for filling large cracks and building up for drainage in areas which would otherwise pond water.

Color coats are usually an acrylic latex material for application over asphalt emulsion sealers. However, color coating materials differ from product to product and the manufacturer's recommendation should be strictly adhered to as to base conditions and application procedure. It is essential that a surface to receive a color coat be corrected to drain prior to application. Color coats should be applied in two coats over completely sealed and drained surfaces for satisfactory results and long life.

REPAIR OF PAVING

Here are some asphalt paving problems and ways to correct them.

Soft Areas

Soft areas may result from oil or gasoline dripping, improper aggregate base, thinned out bituminous paving installation, water penetration and resulting frost heave.

Clean away deteriorated surfaces, apply special asphaltic primer and special sealer-filler to bring up to level, followed by surface seal application as described under "Preventive Maintenance."

When deterioration is severe, it may be necessary to cut out the area and improve the base or increase paving thickness.

Long Cracks

Open cracks may result from alternate expansion and contraction, base settlement or water penetration allowed by neglect of preventive maintenance. It is essential that vegetation not be allowed to take hold in cracks.

Repair procedure should include cleaning out foreign material (in some cases widening the crack for thorough cleaning), filling the crack with a special crack filler product, followed by timely sealing of the surrounding surface as described under "Preventive Maintenance."

Chuckholes and Depressions

Chuckholes are caused by an inadequate base, inadequate paving thickness, water penetration and frost, overloading, or neglect of preventive maintenance. A borderline-quality bituminous pavement may well handle an applied load during summer and winter; however, this same load would be a damaging overload in the spring when frost is receding.

Repair will require cutting out the affected area, correction of the cause, and replacement. The patch and adjacent areas should then be sealed.

Edge Breakaway

Edges break away when the aggregate base is not extended beyond the asphalt paving edge at the time of installation. However, poor surface drainage accompanied by frost cycles also can cause edge failure. Adjacent surfaces should not be allowed to drain onto the edge of bituminous paving.

Correct the cause whether it be bad drainage or inadequate extension of the base outside the edge of the paving. Repair the breakout and reseal.

Deterioration Beyond Repair

Neglect of preventive maintenance, inadequate base or paving depth, poor drainage, or any combination of these causes may lead to deterioration that is beyond repair.

Determine the cause and make needed corrections (such as drainage improvement). Should the old bituminous paving and the old base together make up an adequate base, a new top surface of bituminous paving (at least two inches deep) will result in an adequate paving job.

Topping over old bituminous paving should be preceeded by a special one-coat bonding seal for best results.

RECORDS AND SCHEDULES

All asphaltic paving should be inspected annually in late spring or early summer and an inspection record should be kept on file and updated annually. A sample form for recording inspections is provided in the Mangement Tools Appendix.

19/Maintaining Soft Surface Running Tracks

All-weather, soft-surface running tracks have been constructed of several synthethic paving materials. Some manufacturers, whose materials were used on existing tracks, have discontinued their product lines. The following maintenance information deals with the most common granulated rubber track surfaces used under average conditions. Where unusual circumstances exist, consult the product manufacturer.

CONDITIONS FOR REPAIRS

Climatic conditions must be correct for repairing synthetic surfaces. Air temperature must be 60 degrees F. or above, and must have been so for several days prior to maintenance or repair work. It's also essential that the temperature remain above 50 degrees F. with fair weather for 24 hours following repairs.

The first step is to determine the cause of surface failure. A common problem of the rubber surfaced, all-weather track is in the base asphalt application (commonly called aggregate black-top base). Should a base repair be needed, such repair should be made prior to replacing the rubber surface. Base course repair should be performed as prescribed for maintenance of bituminous paving in Chapter 18.

MAINTENANCE OF THE SURFACE

Every two to four years, depending on geographic location and exposure to hot sun, the surface should be thoroughly cleaned by brooming and water hosing. While still damp (but not wet) treat the surface by spray fogging with SS-1H asphalt emulsion.

The emulsion should consist of a sprayable mixture of SS-1H asphalt emulsion diluted with water. The usual mixture is 50-50 by volume. This treatment may be applied with a brush-type squeegee should suitable spray equipment not be available.

Care should be exercised against either too light or too heavy an application. The surface requires adequate coverage but no puddles should result. Should puddles exist, they should be brushed out while still wet.

MINOR PATCHING

Thoroughly clean all dust, dirt and other foreign materials by brooming and hosing with water. Spray as necessary to provide a clean bondable surface for application of the prime coat.

Prior to patching and repair procedures, the surface must be free of water puddles and damp (not wet).

Prime coat the area to be repaired with a coat of SS-1H asphalt emulsion and water mixture, usually a 50-50 mixture by volume. Apply with a brush-type squeegee or sprayer.

Apply a patching mixture of surface material of mastic consistency suitable for steel troweling in place. The mastic patching mixture should be mixed for application in small batches appropriate for the number of persons troweling. Use the following mixture (based on volume, not weight):

- Two (2) parts clean masonry sand (not too fine) saturated with clean water.
- Two (2) parts undiluted SS-1H asphalt emulsion.
- Mix wet sand emulsion thoroughly.
- Add one (1) part rubber mixture as purchased from the original product manufacturer for patching purposes. Mix thoroughly with the sand and emulsion mixture. This may be purchased in drums and can be stored at proper temperature for future repair work.
- Add water to workable consistency.

Patching in a thickness greater than 3/8 inch must be applied in two or more coats, depending on repair depth needed. In cases requiring a second

coat of patch material, the first application must be thoroughly cured before application of the second coat.

Prior to the second coat, the surface should be dampened. Where the first coat has been in place for too long prior to second coating (that is, appears to have a dulled and dirty surface), the surface should be recleaned, dampened and primed as described above.

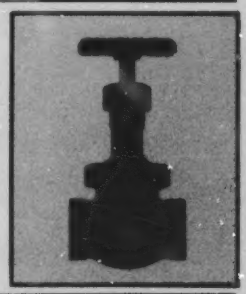
After the patch has set up (no longer tacky) the patched surface should be rolled with a lawn roller to obtain a compacted surface. Following curing the patched area may be scraped (with sharp-edged trowel or blade-like instrument) to level the surface and feather the edges to the adjacent surfaces.

Patched areas should be allowed to cure for at least three days before the track is put into service.

Tools may be cleaned with kerosene or No. 1 fuel oil.

Do not expect repaired areas to reflect the same surface sheen and shade as the adjacent unrepaired surface. Future weather and exposure will blend the surfaces together, but never completely so.

Section Five
MAINTAINING MECHANICAL EQUIPMENT



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Boilers

The boiler in a school building, whether it heats water or generates steam, has been constructed to meet various safety standards, including the code of the American Society of Mechanical Engineers. The burner and its controls are equipped to meet the safety requirements of the municipality and insurance company.

The boiler as purchased and installed is capable of safe, reliable, and efficient operation. Such satisfactory operation can be achieved year after year by following the basic maintenance program described in the operators manual provided with each boiler. This manual is a valuable aid in caring for the boiler.

Good boiler maintenance consists of observing, adjusting, cleaning, and lubricating various pieces of mechanical equipment on a regular basis. Boiler maintenance is either protective or corrective. The two may overlap, but usually protective maintenance tasks are routine and are aimed to prevent breakdown and to prolong the useful life of equipment, while corrective maintenance is the repair or replacement of parts as required by occasional breakdowns.

PROTECTIVE MAINTENANCE

Protective maintenance begins with initial start-up. This is the most important step affecting boiler life and the one that is most often abused. Some contractors, for example, will use a boiler for heating a building during construction, without adequate water treatment or other care for firing requirements. Thus, the school gets a badly scaled or otherwise damaged boiler.

Another important step in good maintenance is to keep a log book. Insurance statistics reveal that 75 percent of all overheating accidents occur at installations that do not use boiler logs. Fewer accidents occur where logs are kept, because equipment maintenance required by a log program usually prevents total failure of safety controls.

Starting Up a New Boiler

Boiler start-up should be performed by the manufacturer's authorized agency. Because of the importance of a proper start-up, the sequence of steps involved is outlined here:

1) Most states require an official inspection. If not, the boiler insurance company will inspect. In either event, the inspection confirms integrity of design and conformance to ASME standards.

2) Inspect all gages, controls, water glass, blowdown piping, relief valves, and others. Short shipments, errors, and vandalism are not unusual.

3) Inspect for foreign objects on both fireside and waterside. Check interiors for rags, scrap material, and tools.

4) Run electrical equipment to check for correct operation and assure lubrication to rotating parts.

5) Fill with water and boil promptly to drive off dissolved gases to avoid corrosion. For steam, fill the boiler to water level. For water, fill the system until the black hand matches up with red hand on the altitude gage. (Be sure the fresh water line is not connected directly to the school water supply unless approved backflow devices are in place and function properly.)

6) Start up the boiler and stand clear of fire doors.

7) Bring up the pressure and temperature slowly. Do not leave unattended while pressure and temperature are rising.

8) Record data in log book. Date and sign start-

up record.

9) Operate steam boiler to clean the system. Run until oil and dirt in the piping have washed out with condensate and goes out the drain. Run until condensate stream is clear.

10) Boil out the steam boiler to remove oil and grease. Fill boiler with water to normal level. Mix concentrate of water and one pound of caustic soda and one pound of trisodium phosphate for each fifty gallon capacity of the boiler. Do not splash on skin, clothing, or eyes. Pour concentrate in boiler. Start firing. Boil water for five to ten hours. Drain and pressure flush the boiler interior. Refill the boiler to normal level and promptly reheat to 180° F. The boiler is okay if the gage glass shows clear water. Repeat if glass shows dirty water. Add boiler compound, such as 95 percent sodium chromate plus 5 percent sodium borate (one pound per fifty gallons of boiler water) to keep pH somewhere between 7 to 11.

11) Boil out the water boiler and system by filling boiler and system with water. Mix in a concentrate of the cleaning compounds — one pound of trisodium phosphate for each fifty gallons of water in the system. Circulate through the entire system for five to ten hours. Drain and pressure flush the boiler interior. Refill the entire system and promptly reheat water to 180° F. Add boiler compound, such as 95 percent sodium chromate plus 5 percent sodium borate (one pound per 1400 gallons of water) to keep pH somewhere between 7 to 11.

Starting Up After a Summer Lay Up

1) Check water level, controls, valves.

2) Check burner operability, fuel, air inlet, exhaust breeching, etc.

3) Open water supply to boiler feed and supply and return valves on the boiler.

4) Start up boiler. Stand clear of fire doors.

5) Bring up the pressure and temperature slowly. Do not leave boiler unattended.

6) Examine all gages and safety relief valves.

7) Record data in log book. Date and sign.

8) On a start-up from cold conditions, condensation may occur but will stop when temperatures are stabilized.

9) If a second boiler is to be cut in after the first is fired up:

- Close its supply and return valves. Open condensate drain valves in header.
- Start up as described for the first one.
- When boiler pressure is up and matches line pressure, open supply valve.
- Open the condensate return valve.

MONITORING BOILER OPERATION

Daily Tasks

1) Read the pressure gages and temperature gages several times daily.

2) Look at the water level glass gage. Water should be visible in the glass at all times. If not visible, shut the burner off. Do not turn on feed water. Do not open safety valves. Let the boiler cool to below 212° F, then add water until one inch shows in the gage glass. Do not start the boiler until the trouble is corrected.

- Water in the gage glass should be clear. Any appearance of rust indicates corrosion. Make chemical check for pH. It should range from 7 to 11. Make check for chromate content.
- Water line should be steady. Bouncing indicates priming or foaming and can be caused by too high a water level, excess dirt, excess oil, excess chemicals, or by over firing.

3) Check the water gage and tri-cocks. Close the lower gage glass valve. Open the drain cock and blow the glass clear. Close the drain. Open the gage glass valve. Water level should bounce up immediately. If not, purge out the lower gage glass pipe line.

4) Check the low water cut-off. Open the drain valve on the water column to lower the water and drop the float. The burner should shut down. If not, have a competent serviceman make repairs before refiring the boiler.

5) Blow down boiler to remove sludge and sediment. A clean, properly maintained boiler should not be drained except to remove sludge, to make repairs, or to lay up for long periods.

6) Turn off the power control switch to observe burner shut-down and the response of the flame failure equipment.

7) Check out the operating point of the operating control and of the high limit control.

8) Keep the boiler room clean. Good housekeeping is essential to efficient operation and safety. Don't let trash interfere with a competent operation.

9) Keep the burner cabinet door closed. Electrical contacts are very sensitive to dust and dirt.

10) Keep a constant check on the fuel supply. Don't depend on automatic delivery. These checks may spot leaks and prevent a hazardous situation.

Weekly Tasks

Each week, inspect the following for proper operation:

1) All linkages on the burner controls and on the automatic draft controllers;

2) Air damper on the burner;
3) Valves in the gas train;
4) Pilot and ignitor, condition of the flame;
5) Low water cut off. Open the boiler drain and blow down until the burner shuts down. Watch the gage glass. The burner should shut off before the water drops out of sight.

Monthly Tasks

1) Check out the operation of safety valves. Make a try lever test. Two people should coordinate for safety. Blow steam for five seconds. Let go of try lever. The valve should snap shut and seal tight. If it simmers, blow again. If valve does not seal after three tries, replace it. CAUTION: Be sure hot water or steam is discharged at a safe point.

2) Check out the limit control on the boiler. Shunt the operating control, allowing operation to continue so that you can check the functioning of the limit control. CAUTION: This step should be performed only by an authorized service representative.

3) Check out the burner flame detection control. Turn off burner control switch and close pilot manual gas cock. Turn on burner control switch, and determine that burner flame safeguard locks out on flame failure before the main gas valve is energized. Immediate corrective action must be taken by a competent serviceman if the flame safeguard does not warp out to indicate flame failure.

4) Blow down the boiler to remove sludge. Open the drain valve at the bottom of the boiler and close it as soon as it is full open. This will usually be enough to remove bottom sludges. On high pressure boilers, there are dual valves. The correct operation is: Open the quick opening valve first, then the slow opening one; close the slow opening valve first, then the quick opening one.

5) Check the floor drains for proper function. If not used often, the water in the trap can evaporate. If necessary, drain water to fill the trap.

6) Lubricate motors in accordance with the manufacturer's instructions. Don't over oil.

Annual Tasks

1) Disassemble the low water cut-off and check for binding, corrosion, or electrical switch defects. CAUTION: This step should be performed by an authorized service representative.

2) Conduct a hydro-test on the boiler and look for leaks at pipe joints and tube joints at the tube sheet. CAUTION: This step should be performed by a licensed boiler repair shop.

3) Inspect the waterside and perform cleaning operation. CAUTION: This step should be performed with the help of a licensed boiler repair shop.

4) Tune up the burner settings. Clean nozzles. The amount of CO^2 present in the flue gas is an important measure of fuel efficiency of any burner. It should average about 10 percent for gas fire and about 12 percent for oil fire. Tune-ups are essential and will yield substantial fuel savings through increased efficiency. CAUTION: This step should be performed by an authorized service representative.

5) Inspect refractory for broken chunks that have fallen out.

6) Inspect the fireside and perform cleaning operation.

7) Check the gas regulator pressure setting. CAUTION: This step should be performed by an authorized service representative.

8) Inspect the boiler room fresh air inlet screens and clean if necessary.

9) Make a safety pop test. CAUTION: This test should be made in accordance with instructions of the government boiler inspector or by a licensed repair shop.

Annual Inspection

Boilers should be included in the annual inspection of heating and ventilating systems. See the Annual Inspection Checklist in the Management Tools Appendix.

CLEANING BOILERS

Inadequate cleaning is a major cause of boiler failure. A number of steps are essential in keeping boilers clean. A need for cleaning usually is indicated when stack temperatures reach 100° F. higher than when the boiler was new and operating under similar pressure and load conditions.

Fireside cleaning: Deposits from fuel, such as sulphur, vanadium, and sodium, are corrosive and should be prevented or removed. Cleaning as follows will restore efficiency (12 to 24 percent) and prevent corrosion.

- Both flue tubes and smokeboxes should be cleaned.
- Soot is removed with air or steam using soot blower jets.
- Carbon is removed with tube scrapers or brushes.
- Cleaning may be done during operation. Cleaning should be done during boiler lay up.

Waterside cleaning: Impurities in water will form scale on metal surfaces and water treating compounds will form precipitates that settle out as

sludge. Cleaning as follows restores efficiency (about 6 to 12 percent) and prevents hot spots and overheating.

- Blow down the boiler at a bottom drain to remove sludge.
- Blow down the surface to remove grease and scum.
- If blowdowns will not provide sufficient cleaning, boil out the boiler once or twice a year.
- If scale needs to be removed, have it done only by a licensed repair shop.
- Feedwater treatment and proper blowdown procedures are important to keep boiler surfaces free of scale to prolong boiler life. Feedwater consultants should be contacted to analyze the water and recommend treatment. Consultants also should recommend the blowdown procedure and frequency of blowdown to reduce concentration of impurities in the boiler.

Note: Water treatment is covered in more detail later in this chapter.

REMOVING BOILER FROM SERVICE

For periods less than one month:

- Drain boiler water while hot, from bottom drain, until it runs clear.
- Refill to the *top* of the water glass.
- Add water treating compound: sodium sulfite to 100 ppm or sodium hydroxide to 400 ppm.
- Boil out all gases and then shut down burner.
- Seal the boiler by closing all boiler operating valves.
- Clean soot off tubes and fireside surfaces. Swab with oil.
- Place one pound of quicklime per boiler horsepower and seal up fireside.

For periods of over one month:

- Drain boiler water completely, while hot, from bottom drain.
- Dry the waterside using hot air or newspaper fire.
- Place one pound of quicklime per boiler horsepower and seal up waterside.
- Clean soot off tubes and fireside surfaces. Swab with oil.
- Place one pound of quicklime per boiler horsepower and seal up fireside.

Be sure to remove the quicklime prior to startup. Use care, as quicklime causes serious skin burns on contact.

CORRECTIVE MAINTENANCE

Corrective maintenance is the repair or replacement of parts as dictated by occasional breakdowns. Major repairs should be done by a boiler serviceman. The following repairs can generally be handled by the school custodial staff.

Leaks

Repair all leaks promptly. All piping connections to the boiler and accessories should be kept leak proof, because even a minor leak, if neglected, may soon become serious. This applies especially to water glass, water level control piping, handhole and manhole gaskets. If serious leaks occur, shut down the boiler immediately, gradually reducing steam pressure. Do not attempt to make repairs while the boiler is under pressure.

Covers and Inspection Plates

Repair leaky handhole or manhole covers by replacing worn gaskets. First, clean the metal surfaces where the cover plate bears against the shell plate. Next apply graphite paste or grease to the gasket to prevent sticking and to make sure it is tight. Always use new gaskets. Make sure the cover plate and gasket are centered before drawing up bolts. Tighten bolts. As steam pressure is raised, tighten these bolts repeatedly to make them leakproof.

Washout Plugs

Use the same method when renewing gasket or washout plugs. Grease the threads so the plug can be easily removed when necessary.

Water Gage Glass

When a water gage is broken, remove the pieces and slowly open the valves to blow out any remaining particles of broken glass. Before inserting the new glass, be sure it is the exact length required and that the connections line up. Otherwise it will break as it expands with the heat. Insert the new glass with rubber gaskets, brass rings, and stuffing box nuts. Take care not to set the nuts too tightly in order to allow for expansion from heat. Crack the top valve slightly to let a small current of steam flow through the glass to warm it gradually. Close drain cock and open bottom valves slowly. When water level is stable, open wide both top and bottom valves.

Gas and Oil Burners

An effective preventive maintenance program is absolutely essential to the safe, dependable, and efficient operation of fuel burning equipment. Preventable equipment failure—causing a boiler to overheat—is extremely expensive in terms of replacement equipment and days of school lost. In addition, a good maintenance program will result in more efficient fuel use and reduce energy costs.

Effective maintenance begins with knowledge of the equipment and how it should operate. Thus, preventive maintenance begins with these first steps:

1) Obtain two copies of the parts and service manual from the manufacturer. Data and instructions for allied equipment, such as combustion safety equipment and automatic valves, should be included in this book. If they are not provided, take steps to complete this manual by contacting the various manufacturers directly or asking the boiler manufacturer for them. One copy of the manual should remain in the boiler room and the other in an office file. Be certain that the wiring diagram, sequence of operation, the piping diagram showing valve train, and other necessary information for the particular installations are recorded in this manual.

2) Before attempting to maintain the burner, it is important to know exactly how the burner should operate. Obtain this information from the consulting engineer or the burner manufacturer, using the Burner Information form provided in the Management Tools Appendix. This form should be put in the office files and the information recorded in the parts and service manual.

3) On a new installation, see that the maintenance team receives a demonstration of the burner operation by either the contractor or the burner manufacturer's representative. Be sure to get a clear and accurate explanation of every step of the burner operation and what precautions to take in the event the equipment fails to operate.

4) Obtain a recommended list of replacement parts from the burner manufacturer's representative and then determine what parts will be maintained in stock. Obviously, the distance and time from the source of supply are important factors in deciding what spare parts to stock.

5) Determine what service organization will be used. Record day and night telephone numbers, addresses, and other needed information near a light in the boiler room, as well as in the parts and service manual. This information should be readily available so that even a person unfamiliar with the burner operation could, in an emergency, call for service.

MAINTENANCE SCHEDULES

Once the operators are familiar with burner operations through both demonstration and reading of the parts and service manual, a maintenance schedule should be drawn up. The printed schedule should outline what is to be done and should be arranged so that each operation can be recorded and initialed by the operator doing the job. This will provide a permanent record of the daily service performed. The following services and frequencies are suggested:

Daily

1) Observe the burner operation as it goes through its various cycles, visually checking the gas or oil pressure in either the steam or hot water temperature.

2) Visually inspect the fire. In the case of oil, make sure that combustion is good and that smoke is not being produced. Any fire contact with the side walls of the boiler can form carbon deposits.

3) Keep the burner equipment, controls, and premises clean. If using fuel oil or any lubricating oil, visually check for leaks, determine cause, and correct promptly.

Weekly

Determine that each of the following controls is working properly:

- Low water cutoff.
- Operating control.
- High limit control.
- Electronic safety combustion control—simulate both main flame and pilot failures.
- High ambient temperature alarm.
- Alarm bells and lights.
- Emergency switch.
- Operation of both high and low gas pressure switches—high gas pressure switch cannot be simulated; however, it should be disconnected electrically to be certain of its operation.
- Thermal switch on a barometric damper, if used.
- Low oil pressure switch, if used. A clogged strainer, air leaks in the suction line system, or loose strainer cover will cause oil pump pressure to drop.
- Clean the oil suction strainer. If the compound

gage shows a higher vacuum than normal, this indicates that the strainer screen is obstructed with dirt, sludge, or wax.

- Lubricating oil level in compressor oil reservoir. Add oil if necessary.
- Make sure the recommended oil for compressor is used, not a substitute.

Monthly (Mainly for fuel oil systems)

1) Check conditions of the nozzle. Remove the nozzle unit or drawer assembly depending upon the type of burner, whether natural or forced draft type. If No. 2 oil is used, the nozzle should not require cleaning, but inspect it for carbon deposits. The heated oils, heavy Nos. 4, 5, and 6, may cause carbon deposits on the outside tips of the nozzle. Also, residue can collect in the inside mixer. Clean carefully. Do not use tools that will mar the machine surfaces, slots, or holes in both the inside and outside nozzle tips. Be careful to reassemble the nozzle correctly, and do not change the position of the diffuser or flame retention head.

2) On burners with diffuser or flame cone as part of the drawer assembly, remove any deposits that might have formed. If the burner housing or register has a hinged swing-out section, inspection can be made with the diffuser in place.

3) If the burner is a combination gas/oil type, be sure the gas orifices are free of any obstruction.

4) Check compressor operations, noting lubricating oil level and refilling it if required. Be sure the automatic sight flow indicators are clean and show rate of lubricating flow. Clean the sediment strainer in the oil supply line to the compressor. Rotary compressors may be furnished with the lubricating oil contained in a base reclaimer, overhead attached type or separately mounted. These use either suction or air pressure to force feed oil. Overhead suction reclaimer uses an automatic shutoff device to prevent oil flooding when the unit is not operating. Be sure the automatic oil feed valve is operating properly.

5) Reciprocating or piston type compressors requiring lubrication have the oil supply in the crank case. Add oil if the level indicator shows low oil. Some compressors may be the direct-connected oilless type requiring no lubrication.

6) Compressors of all types are equipped with intake air filters which must be kept clean.

7) If the compressor is driven by "V" belt, wipe the belt clean and tighten if necessary. Follow the instruction manual.

8) Clean the dirt from the scale strainer screen mounted on the electric oil heater discharge and strainers in any other location in the supply line to the burner.

9) Lubricate the bearings on the burner jack shaft and all linkage that operates air louvers and fuel valves.

10) Note the operation of the oil pump, which may be either integral or remote. Noisy operation may indicate either clogged strainer causing high vacuum or air leaks in suction line or shaft seal causing low volume. Also, a low suction temperature when high viscosity oils are burned will cause pump noise.

11) If the oil pump is "V" belt driven, adjust it to the proper belt tension.

12) Inspect the electronic flame safeguard and all motor starters, contactors, and relays. Clean all contacts with recommended cleaning fluid. Never use emery or sandpaper.

Semiannually

1) With instruments, measure and record: stack temperature, CO^2, and electrical signal strength of the electronic flame safeguard system. On gas-fired burner, check CO^2; on fuel-oil burner, check smoke scale.

2) Check belts; tighten or replace as required. Oil or grease motors. Some motors do not require either grease or oil; others require it only once or twice a year. Follow the instructions of the motor manufacturer.

3) On oil systems, drain oil from compressor reservoir, flush out with light flushing oil, and replace with fresh oil.

4) Inspect boiler tubes or flue passages and clean out any ash or soot. If the boiler has spitter blades or tubulators, be sure they are clean before replacing them—they are essential to efficient boiler operation.

Annually

1) Replace electronic tubes.

2) Replace electrodes and insulator in the gas electric ignition system.

3) On oil burners, check the oil filter and replace cartridges.

4) If the oil burning system is equipped with steam or hot water operated fuel oil heaters of the straight or bent tube type, they should be cleaned if required. Usually tubular oil heaters should not require cleaning the first year unless the oil heating capacity drops while all other conditions remain normal. First check operation and calibration of the steam oil temperature controls, because a heater may deliver oil at too low a temperature if

a regulator is defective or out of adjustment. Steam capacity to the heater may be reduced by a clogged steam strainer ahead of the regulator. The steam trap may not operate properly, causing reduced heater efficiency, if its strainer is dirty or the float is not free to operate the condensate valve. If the trap valve does not open, the entire heater will become waterlogged; or if the trap valve remains open, live steam will be blowing through at all times. Some types of traps operate on the impulse principle without having a float mechanism.

5) Hot water oil heaters may be operated with gravity or forced flow hot water using a circulating pump controlled by an immersion temperature control. Be sure the pump and control are operating properly to maintain the established oil temperature.

6) If an electric heater is used on the burner, it should be drained to remove any sludge. After the first year, it would be well to remove the heater element once a year to clean out any heavy residue coating on the heater or the interior of the shell or manifold.

7) Inspect the entire refractory in the boiler and burner throat and determine repairs which must be made. A setting will last longer if the small repairs are made regularly instead of waiting for a major replacement. Also, major replacements are more expensive.

8) Have the service organization that is working on the burner check over the complete operation of the burner, tightening linkage and doing whatever is necessary to put the burner in first-class operation. This should be done either in late summer or early fall. Require a written report from the service organization as to what was done and the overall general condition of the burner.

Annual Inspection

Burners should be included in the annual inspection of heating and ventilating systems. See the Annual Inspection Checklist in the Management Tools Appendix.

Summer Shutdown

Assuming the burner is not used during the summer, it should be shut down as follows:

1) Shut all manual valves. These generally include the main line lubricated plug cock and the pilot line cock. It is not advisable to burn the pilot during the summer to keep the boiler dry. Moisture generated by combustion is usually greater than the condensation that occurs without a flame. If heat is necessary, an electric light bulb is preferable to a gas pilot.

2) Put the safety combustion control relay in the safety lock out position.

3) Put all disconnect switches relating to the gas burner in the off position; however, the equipment panel should be left on to maintain sufficient heat to remove the formation of moisture that may form within the panel.

4) The boiler section of this manual contains more explicit steps that should be taken for summer shutdown.

SERVICING

Before attempting to troubleshoot, keep in mind that all servicing and adjustments to the burner should be performed only by qualified burner service personnel. Scheduled inspection and maintenance can be performed by the building maintenance team.

1) Make certain that the combustion chamber and flues are purged of any unburned fuel before restarting the burner following any brief shutoff.

2) Always follow the burner operating sequence instructions in turning the burner on or off.

3) Always open disconnect switches before loosening or tightening the flame safeguard mounting or terminal screws.

4) Make certain that all electrical connections are secure, including the flame safeguard relay mounting connections.

5) Never oil any portion of the flame safeguard relay.

6) Unnecessary shutdowns may be prevented by the annual replacement of the flame safeguard vacuum tube (if used), periodic inspection to remove dust and dirt, and periodic checks of burner adjustments.

Maintenance personnel should be familiar with the burner system and all associated parts. An orderly way of checking for failures should be developed. In troubleshooting, maintenance men should keep in mind to start simple. Go on the assumption that the problem is minor, because in most cases it is. Do not look for complicated problems.

With the aid of a wiring diagram, a sequence of operation table and a voltmeter, first check at the source of power to ensure that the signal levels governing burner sequence are proper. Do not spend too much time in any one particular location of the circuit. Above all, recognize operator limitations. Operators can introduce additional problems to the burner if they are not thoroughly familiar with the sequence of operations and con-

trols associated with it. Knowing his own limitations should tell the operator when to stop.

FAILURES

Upon detecting the cause of burner failure, correct it if possible. If the operator cannot correct the problem, but knows the cause of failure, inform the burner service company of the cause. This effort will save time and money. There are three primary ways to check the unit:

Sight—When performing daily inspection of the burner, note the appearance of the flame—color, shape, and the distance it is firing down the tube at low and high fire. If any changes occur, the maintenance man has a clue to possible trouble. For example, there may not be enough air for complete combustion. This could be the result of insufficient air makeup within the boiler room or the air linkage may be out of adjustment.

Sound—The burner should sound the same each time it lights and goes through its sequence of operations. Any detectable change could inform the operator of potential burner problems. For example, the burner should light with a smooth sounding start. If it huffs and puffs at the start, the cause might be venting blockage in the gas train, a pilot too small, too much air, or other problem.

Smell—If any unusual odors are smelled, this may lead the operator to suspect that some of the flue combustible materials are leaking within the room. The cause of such a problem might be an insufficient amount of air for complete combustion, slippage on air louvers, or a similar problem.

The following should be done prior to calling the service organization:

1) Check to see if power is available to the burner.

2) If there is no power, check fuses, emergency switch, control switch, and summer-winter or heating-standby switches. Reset all safety devices.

3) If there is a fuse-link switch located above the boiler, check to make sure it is functional. The burner may have gone off on high temperature.

4) Check the low water cutoff; some have manual reset.

5) Check the high steam pressuretrol or high water pressuretrol or temperature controls associated with the burner. Many of these have a manual reset and may have been tripped due to burner conditions.

6) High/low gas pressure switches have manual reset switches. They may have been tripped by unusual gas conditions within the area.

7) Check gas cocks and burner fuel supply.

8) Check the flame safeguard for safety shutdown and lockout.

9) Visually inspect the sequencer, internal fuse, tubes, and flame scanner.

10) Check the low fire start switch on the burner.

11) Check the combustion air damper motor and the end switch.

12) Check the thermo switch associated with the barometric damper if the system has one.

13) Check the inducted draft fan and associated fuses, broken belts, or burned out motor.

14) Check burner motor overloads on the starter and panel or on the motor itself.

On completion of the basic checks listed above, note which safety had the unit off and correct the failure. If none of the above can be picked as the cause of the problem, call the service organization that normally maintains the burner equipment and advise them of the steps taken.

Water Treatment

Water for heating, cooling, and other uses generally comes from underground or surface water sources and usually contains impurities.

These impurities are usually classified as dissolved solids, dissolved gases, or suspended matter. Water is a universal solvent. Almost all substances will partially dissolve in it. To some degree water will dissolve rock, soil, and many metals. It will absorb gases, including air and gases formed by organic decomposition.

In general, underground waters are consistent relative to composition, temperature, and hardness. They usually contain less suspended matter and turbidity than surface waters.

The vast amount of water available and its tremendous capacity for absorbing, releasing, and storing heat make it ideal for use in heating and cooling. Before using any water, however, the impurities must be removed or controlled by water treatment.

THE CHEMISTRY OF WATER

A few basic facts regarding the chemistry of water might be helpful.

The *pH* (chemists' abbreviation for the degree of acidity or alkalinity) of water is a delicate balance between hydrogen ions (H+) and hydroxide ions (OH-). When the hydrogen ion (H+) predominates, the water is acidic. If the hydroxide ion (OH-) predominates, the water is alkaline. The degree of acidity or alkalinity is determined by the relative amounts of H+ and OH- ions. This degree of alkalinity or acidity is based on a scale of 0 to 14. Above pH 7, water is considered alkaline; below 7 it is considered acidic. At pH 7, water is considered neutral, but it is aggressive.

The alkalinity of water is influenced by hydroxide ions and by carbonate and bicarbonate ions. When water is tested for alkalinity, test for the combined amounts of hydroxide, carbonate, and bicarbonate ions. This amount is normally reported as ppm (parts per million) or mg/l (milligrams per liter) calcium carbonate. When testing for pH, measure the relative amount of hydrogen and hydroxide ions present.

Some waters contain calcium and magnesium salts in great abundance. The amounts of these particular impurities constitute the hardness of the water. They make water difficult to wash with because they react with soap to form a curd. Like alkalinity, the hardness is reported in grains, ppm or mg/l calcium carbonate.

There are many other factors which influence the chemistry of water, but these are the basic ones.

WATER BOILERS

Water boilers are perhaps the easiest to treat. A treatment which has been found to work well is to add baking soda to achieve and maintain a pH of 8.0 to 8.5. The pH of the boiler water should be tested monthly to determine if it is in the proper range. Lower pH may produce corrosion on the water side of the boiler. Additional baking soda should be added if necessary.

Wnere high pH is not practical, chromates and nitrites have been used as corrosion inhibitors. The discharge of these chemicals to a sewer could disrupt a sewage treatment plant and cause it to pollute the natural waters. Therefore, their use should be minimized.

pH can be tested by using pH indicator paper available from any laboratory supply company. The school chemistry laboratory may have a pH meter. If so, use it.

The boiler should be flushed and refilled as required to remove sediment. Be sure to bring the pH back to 8.0 to 8.5 after refilling.

STEAM BOILERS

The water treatment program best suited to any steam boiler system depends upon the amount of make-up water needed by that system. The primary objective of any steam boiler system is to keep the amount of make-up (fresh water added to the system) to the minimum required by the system. Doing this conserves energy needed to heat the fresh water, reclaims the maximum amount of valuable pure water (condensate), minimizes water treatment chemicals required, minimizes make-up water pretreatment (softeners, deaerators, etc.), and keeps the boiler treatment and blowdown program as simple as possible.

Most school boilers are designed as low make-up boilers used for building heat only. Intentional steam losses for such areas as humidification are relatively rare. Unintentional steam/condensate losses are very costly and should be immediately repaired. This includes leaking traps causing steam losses through vents at the condensate receivers.

Steam/condensate losses in a steam system are especially wasteful as the hot, distilled water being lost has to be replaced by cold, contaminated make-up water.

Some boiler blowdown and make-up water additions, however, are necessary in all types of steam boiler systems. Control lines (such as low water cut-offs) should be briefly blown down to keep them operating safely. In addition, the boilers should be blown down from the lowest opening to remove sediment.

The treatment of steam boilers amounts to the control of four factors: (1) boiler deposits, (2) corrosion, (3) foaming, and (4) caustic embrittlement.

The main source of boiler deposits is the dissolved minerals contained in hard water. These deposits are generally classified as scale or sludge (mud). The term scale is used to describe the deposits which adhere to boiler water surfacen. The deposits which do not adhere (drop off) are called sludge. The purpose of boiler treatment is to chemically change dissolved minerals which will form scale in the boiler to an inert form of sludge which can be removed from the boiler by blowing down or flushing.

The treatment of mineral matter (hardness) in the feed water can be handled by external softening or internal softening. Water is softened externally prior to entering the boiler by installing a

softening system, such as a sodium zeolite or lime softening system.

Hardness can be removed internally by adding to the boiler water one of the sodium phosphates listed below:

Mono-sodium phosphate, anhydrous
Mono-sodium phosphate
Di-sodium phosphate, anhydrous
Di-sodium phosphate
Tri-sodium phosphate
Sodium meta-phosphate
Tetra sodium hypo-phosphate

The phosphate level should be maintained at 30 to 60 ppm. This results in zero hardness of your boiler water.

In the past few years another treatment for hardness has proved successful. This treatment uses chelates such as EDTA to modify complex calcium ions and magnesium ions so they are harmless to the system.

Corrosion in boilers is usually caused by dissolved oxygen reacting with iron in the boiler and by carbonic acid, which is produced when carbon dioxide dissolves in water.

Dissolved oxygen can be removed externally with mechanical deaerators. Some type of chemical internal removal should also be used, however. Internal dissolved oxygen is removed by the addition of sodium sulfite (oxygen scavenger). A level of 30-60 ppm sulfite should be maintained in the boiler at all times. Hydrazine is also used, but usually only in high pressure boilers.

Carbon dioxide is removed by creating an environment in which it cannot exist. This is handled by adding caustic soda (NaOH) to the boiler water to produce a pH of 10.5 to 11.2. Once a pH level of 10.5 is established, it will normally remain in the proper range. If the pH exceeds 11.2, the danger of caustic embrittlement of the boiler metal exists. If this high pH occurs, quickly drain and flush the boiler, refill, treat with chemicals and resume operation.

Foaming and/or priming in a boiler are usually caused by oil or excessive solids (dissolved or suspended) in the boiler water. If the problem is caused by oil, the source of the oil should be located and eliminated. The dissolved solid levels in the boiler are controlled by blowdown. The only measurement of blowdown is the chloride level in the boiler water. A chloride level of 80 to 100 ppm normally indicates adequate blowdown. Higher chloride levels indicate insufficient blowdown and that solids may be high enough to cause foaming.

There is a simple test to determine if a steam boiler is foaming or priming. Build up a reasonable load of steam in the boiler and then very slowly open the safety valve on the boiler. If water is discharged through the safety valve, the boiler is priming or foaming, and the oil or solids must be removed. CAUTION: The water which is discharged by the safety valve is scalding hot; stand clear of the valve and the water stream.

Oil can be removed from a boiler by using Sal Soda as follows:

1) Completely drain the boiler from all low points to remove all possible sediment.

2) Add water and Sal Soda to the boiler until it is filled to the proper operating level. Use Sal Soda at the rate of 5 to 10 pounds per 100 gallons of boiler water.

3) Gradually heat boiler water. All air and steam should be carefully vented to the atmosphere.

4) Continue to heat the boiler water, and when the water becomes hot, slowly add additional fresh water to overfill the boiler through the highest available opening to remove any oil deposits which float on the water surface.

5) Maintain the water at boiling for at least an hour and then slowly drain the water completely.

6) Refill the boiler with water and again overfill it. Again heat the water to boiling and completely drain again.

7) It may be necessary to repeat steps (2) to (6) several times to fully clean the boiler and step (6) two or three times to completely remove all traces of Sal Soda.

8) Refill the boiler to the normal water level and add required treatment chemicals.

In high pressure boilers, the breakdown of bicarbonates in the boiler water can form free carbon dioxide (CO^2), which will leave with the steam to the system. In turn, this free CO^2 forms corrosive carbonic acid when it dissolves in the water in the return lines, producing vigorous corrosion. This corrosion of the condensate lines can be controlled by using filming amines, such as octadecylamine or octadecylamine acetate, introduced into the boiler water. Neutralizing amines such as marpholine or cyclohexylamine can also be used.

Ideally, boiler water should be tested at least monthly for the following:

Test	Desired Concentration
pH	10.5 to 11.2
Alkalinity (MO)	200 to 300 ppm
Hardness	Less than 1 ppm
Sulfite	30 to 60 ppm
Phosphate	30 to 60 ppm

If these levels are maintained, boiler operation

can be efficient and at lowest cost.

Chemical additions can be made directly to the condensate return tank in powder or liquid form at least weekly. Ideally they should be added continuously by a proportional feed pump connected to the condensate pump discharge line between the condensate pump and the boiler. It should be activated when the condensate pump is operating.

Improperly treated boilers may require manual or chemical removal of scale deposits. Chemical cleaning is difficult and dangerous. It should only be attempted by experienced personnel. Manual cleaning is expensive.

COOLING TOWERS

The treatment of cooling tower water involves the control of (1) microbiological deposits, (2) scale deposits, (3) corrosion, (4) mud and other deposits, (5) foam. Cooling tower water treatment recently has become a problem because of the potential pollution hazard of treatment chemicals.

Seek a treatment which is effective, yet non-polluting. The use of polluting treatments such as chromate/zinc or chromate/zinc/phosphate will mean the use of expensive pollution control equipment to avoid violations of environmental protection standards.

The best solution is the service of a reputable chemical treatment company. They will evaluate the system and provide an effective non-polluting type of chemical treatment. Many treatments of this type are available but they must be suited to a particular system.

Domestic Hot Water Treatment

The most common problem encountered in domestic hot water systems is the corrosion of pipes by extremely soft water. The softening system should maintain a safe hardness level of 4 to 5 grains per gallon. It should be tested regularly for hardness.

Another common problem is that of scaling of pipes. Control can usually be accomplished by the use of sodium phosphates, sodium silicate, or a combination of the two. Additions should be made with a proportional feed pump. The chemicals used must be approved for human consumption and must be mixed and dispensed under hygienic conditions.

Chillers

Chiller protection by chemical treatment is necessary for efficient operation. These systems are delicate and must be treated properly at all times.

The best treatment is the addition of 2 or 3 ppm of sodium chromate to the chiller water. This level must be checked at least monthly to determine if more chromate must be added to maintain the proper 2 to 3 ppm level.

Pumps

Pumps installed in schools are confined mostly to a small range of types, thus simplifying maintenance.

Pumps circulate or move water, either in a "closed" system where the water is used over and over again (as in heating or cooling), or in an "open" system where water is consumed or replaced (as in a sump pump or domestic hot water pump). All of these pumps fall into the general classifications which are described in the table on the next page.

Pumps should be inspected weekly and maintenance performed as follows:

1) Motors and pumps must be oiled or greased in accordance with the manufacturer's directions. Do not over oil motors and be sure to use the proper lubricant. Pumps with oil cups must be visually inspected to assure proper oil level. Grease lubricated pumps must be inspected every 90 days and lubricated if necessary. It is far better to lubricate with small quantities at regular intervals than to over lubricate.

2) Couplers should be checked at regular intervals, particularly the solid disc types. Worn disc couplers or malfunctioning spring couplers can be a primary cause of bearing failure.

3) Rubber mounted motors should have mounts checked annually for deterioration and all bases checked for loose mountings.

4) Mechanical seals require no maintenance. If seals leak, they should be replaced or they will continue to leak at an increasing rate.

Types of Pumps

Here are four classifications of pumps most likely to be found in a school building:

1) In-line circulators, which are mounted directly in the pipe line.

2) Base-mounted pumps, which have pump and motor mounted on a common base and connected through a coupling. These pumps may be vertical or horizontal split case, may be single or double suction, and may have suction and discharge openings located in the end, side, or top.

3) Close-coupled or built-together pumps, which have the impeller located on the end of an extended motor shaft.

4) Peripheral turbine pumps, which can be arranged physically as base-mounted pumps or close-coupled pumps, but have different hydraulic characteristics. If this type of pump is found in a school, it will usually be in boiler feed service. Unlike straight centrifugal pumps, turbines can require impeller adjustments which should be performed by an experienced mechanic according to the manufacturer's recommendations.

All pumps in these categories have some common characteristics and terminology. These terms are as follows:

Electric motor driven, in which the motive power is an electric motor.

Turbine or steam engine driven, in which the motive power is steam or water under pressure.

Stuffing box, in which a variety of mechanical seals or packing may be installed to seal the pumped fluid from the atmosphere.

Mechanical seals do not leak when operating properly, while *packing* requires a certain amount of leakage for lubrication. For this reason, a packed stuffing box is not generally used in a closed water system unless the fluid temperature exceeds the limits of mechanical seals.

Oil lubricated or grease lubricated pumps. The difference between these can be observed generally by the type of fitting provided for lubrication or from the manufacturer's directions.

Removable bearing brackets or internal bearing supports.

Flexible couplers, which allow limited movement between pump shaft and motor shaft, or solid couplers in which the pump shaft and motor shaft are rigidly connected.

All iron, bronze fitted, or all bronze pumps, selection of which generally depends upon pump usage.

5) "Stuffing boxes" should be checked regularly and should be repacked by an experienced pump specialist when leakage becomes excessive.

6) After extended shutdown, pump and motor shafts should be turned manually to see that they turn freely and that any deposited sediment is churned before the motor is started.

7) When reinstalling a motor, the shafts must be carefully checked for alignment.

8) Any pumps that are drained and left idle require careful lubrication and the interiors and impellers must be rustproofed.

9) Strainers on the pump suction must be checked at regular intervals and cleaned. The intervals will depend on the amount of water make-up, type and age of piping, etc.

COMMON TROUBLES

Following is a listing of the most common troubles and their probable causes.

Vibration noise can be caused by any of the following:

- Misalignment of motor and pump shafts; they should be within .005 inches both vertically and horizontally.
- Loose pump and motor base mountings.
- Pump base is inadequately "grouted." This means to fill under the base with cement made with a mixture of three parts sand to one part cement.
- Pipe strain on either suction or discharge connections.
- Check pump coupler.
- Broken or worn springs or arms on flexible coupler.
- Worn discs in solid-type coupler.
- Worn motor bearings.
- Worn pump bearings.
- A common misconception is that flexible pipe connectors eliminate vibration. They are primarily for pipe misalignment.

Cavitation noise (sounds like pumping gravel) can be caused by:

- Air in the system. Each system should have some device (air separator, dip tube, etc.) for separating air at the boiler or converter. Do not depend

upon automatic air vents for air removal.

- An inadequate supply of water to the impeller. Check for adequate water level in the system.
- Inadequate system pressure. Check gage on pump suction, both with pump running and with pump off. The pressure must be adequate to supply water to the highest point under all conditions. (Gage reading "Vacuum" indicates condition that can damage pump.)
- Inadequate length of horizontal piping on suction side of pump.
- Misplacement of expansion tank; it should be on suction side of pump.
- Inadequate size of suction piping; it must be full size of pump inlet.
- Motor amperage not within motor rating. If above normal, close the pump discharge valve until amperage drops to normal. (Does not apply to peripheral turbines.) If normal amperage cannot be achieved, check with consulting engineer.
- Fouled strainer; always check to insure that it is clear.

Squealing noise may be caused by a lack of lubrication on either pump or motor. It may mean bearing or seal trouble. If squealing comes from the stuffing box, there may be too tight an adjustment on the "gland."

Mechanical Failures—Motors

1) If motor does not reach running speed, check for a defect in the running winding or in the starting switch.

2) If a motor will not start:

- Check overload heaters and contacts if a starter is used.
- If fused, check fuses.
- Disconnect the coupler from the pump shaft. Motor should turn easily by hand. If too tight, then the bearings are bad. If there is too much end-play, then the bearings are worn.
- Turn on motor and see if it operates with no load.

Mechanical Failure—Pumps

"Frozen" shaft on a pump may be caused by lack of bearing lubrication, by a foreign object caught in the impeller, or by corrosion around the seal or impeller.

For any of these difficulties, pumps of the vertical or horizontal "split case" design may have removable bearing brackets and may be serviced without disconnecting the piping or misaligning the motor. Other styles must be serviced by removing the suction piping before working on seal or impeller.

Safety

Pumps should be treated like any other piece of rotating machinery. All exposed rotating parts should have a guard. When performing maintenance other than lubrication, the local controls as well as the main power disconnect should be turned off and tagged.

Energy

In the original design, efficiency was a consideration in pump selection and system design. However, there may be cases where a pump must be "throttled" to achieve proper system balance. If this occurs, it might be advantageous to trim the impeller to meet this condition without throttling. This can result in a lower amperage draw. The design engineer can advise whether this possibility exists.

Annual Inspection

Pumps should be included in the annual inspection of heating and ventilating systems. See the Annual Inspection Checklist in the Management Tools Appendix.

Steam Traps

For steam traps in normal service, a typical preventive maintenance schedule is shown in the table on page 144. However, if the traps are subjected to severe service (water hammer present, excessive condensate loads, large amounts of dirt or scale), more frequent inspections and replacement of parts may be required.

Steam traps can fail in two ways — fail to open and fail to close. When a trap fails to open, condensate accumulates in the drip leg and eventually floods the heat exchange equipment. Conversely, when a trap fails to close, it wastes an impressive amount of live steam. The cause of a trap to fail — open or close— varies for different types. However, there are certain things that happen when any trap fails.

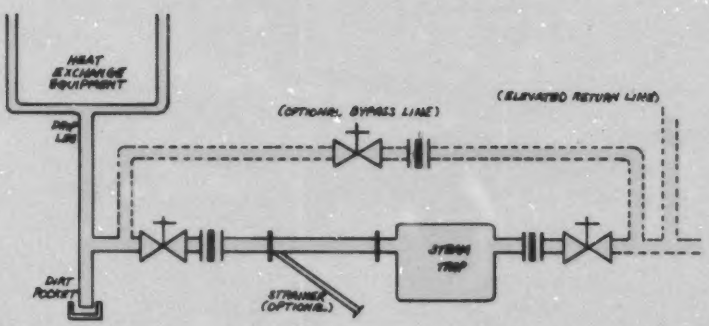


Figure 20-1—A typical steam trap installation.

Safety

When working with steam traps, remember that they are pressure vessels and contain hot fluids under pressure. *Never* attempt to open a trap body without first turning off the valves in the inlet and discharge lines and allowing the unit to cool.

When testing traps where condensate return lines are overhead, guard against the backflow from other traps or from the return lines. Aside from being a safety hazard, this backflow can produce false indications during trap testing.

When operating the steam trap with a test cock or union connection open, keep away from the hot condensate. Also, do not attempt to direct the trap discharge into a shallow pan, as velocities may be sufficient to scatter the hot liquid and cause severe burns.

CHECKING TRAP OPERATION

There are several methods of checking steam trap operation. (See Figure 20-1.) One of the easiest methods is to measure the temperature of the piping on each side of the trap. The inlet piping should be hot, and the discharge piping much cooler. Use any good temperature measuring device, such as a pyrometer, to make the readings. If such a device is not available, put on a good pair of heavy work gloves and take hold of both pipes. A temperature difference between the trap inlet and discharge lines can be felt. If both pipes are cold the condensate is not being removed from the heat exchange equipment. The trap may not be opening, or the line may be blocked. If both inlet and discharge lines are equally hot, indications are that the steam trap is not closing properly. Check other traps on the same discharge line. Often the failure of one trap produces high temperatures downstream of other traps that use the same return main.

Another method for checking steam trap operation is to observe the steam trap discharge. In some installations, a test cock is provided in the trap discharge line. In other installations, it is necessary to open a union connection downstream of the trap to observe the discharge.

Warning: The discharge from steam traps is hot condensate (scalding water) under pressure. When released to atmosphere, the condensate produces considerable "flash steam." Don't get burned. Close valves and allow trap and piping to cool before opening any union. *Be sure* that a valve downstream of the trap is closed to avoid backflow from the return main.

When the steam trap is operating with an open discharge line, notice the type of discharge and the volume of condensate compared to that of steam. Inverted bucket, thermostatic, and disc (impulse) traps have intermittent discharges, accompanied by clouds of flash steam. (See Figure 20-2.) If a disc

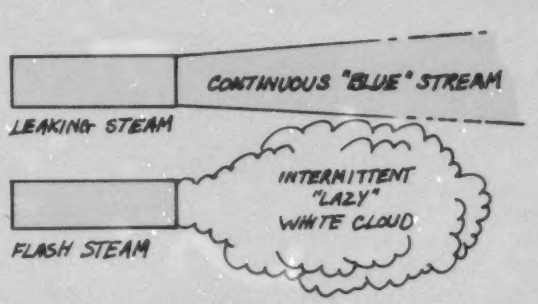


Figure 20-2—Don't confuse flash steam with leaking steam. To tell the difference, open the outlet line. If steam blows out in a continuous "blue" stream, it is leaking steam. If steam floats out intermittently (each time the trap discharges) in a white cloud, it is flash steam.

Typical Preventive Maintenance Schedule

Procedure	Type of Steam Trap			
	Inverted Bucket	Float and Thermostatic	Thermostatic	Disc or Impulse
Check trap operation	2 months	2 months	2 months	2 months
Clean strainer ahead of trap	4 months	4 months	4 months	4 months
Open trap and clean; replace worn parts	12 months*	12 months*	12 months*	12 months

*Experience will dictate frequency of trap cleaning and parts replacement.

trap discharges more often than 10 times a minute, it is a sign of wear and should be replaced or repaired. Float and thermostatic traps discharge condensate continuously as it enters the trap body. Because of the continuous drainage, it is more difficult to distinguish between live steam and flash steam.

When a steam trap appears to be faulty, check the other elements in the pipe lines to be sure that the fault is in the trap. Valves in the trap inlet and discharge lines should be fully open. If there is a bypass around the trap, its valve must be closed tightly. If there is a strainer ahead of the trap, be sure that the screen is not clogged by dirt and scale.

Also check the condensave line downstream of the trap to be sure that it is not fully or partially blocked. If the condensate is discharged to an overhead return line, be sure that the pressure at the trap outlet is sufficient to do the lifting. For systems above 15 psig, pressure must be about 1 psi for every 2 feet of lift. For systems below 15 psig, use 1 psi for each 1 foot of lift.

STEAM TRAP REPAIR

When the trouble has been traced to a particular steam trap, close the inlet and discharge valves and allow the trap to cool. To minimize downtime, remove the faulty trap or trap mechanism and immediately replace it. The faulty trap or mechanism can then be repaired and stored until needed.

Inverted Bucket Traps

To repair an inverted bucket trap (see Figure 20-3), open the trap and discard the old gasket. Scrape gasket surfaces clean. Remove excessive scale and dirt from the inside of the trap body. Place the cap in a vise and remove the bucket from the lever. Clean the bucket, making sure that the vent hole at the top of the bucket is open. Inspect the valve lever and valve guides for wear. Inspect the valve and seat. There should be a narrow, bright ring around the valve and a sharp edge on the valve seat. If any of these parts are worn, it is good preventive maintenance to replace all parts. When replacing the valve and valve seat, be sure that both new parts are of the correct orifice size for operating steam pressure.

Some inverted bucket traps have thermal elements. One type has a bi-metallic strip that closes a secondary vent in the bucket. Inspect the thermal element for wear, misalignment, or other damage. When placed in a pail of boiling water, the vent should close. If the thermal element in the bucket is faulty, replace the bucket. Another has a diaphragm or bellow in the cap. If it has failed, replace the element. (Do not check this type in boiling water.)

After installing the necessary parts in the trap mechanism, align the assembly so that the lever moves freely and the valve seats tightly on the orifice. When the mechanism is aligned so that it operates freely, attach the bucket to the end of the lever. Using a new gasket, reassemble the trap and tighten bolts securely, opposite ones first.

On some occasions, an inverted bucket steam trap won't close because it has "lost its prime." It can be reprimed by closing the valve in the trap inlet until the condensate accumulates in the drip leg; then *slowly* open the valve and let the water enter the trap. If the trap does not then function properly, something else is probably the cause.

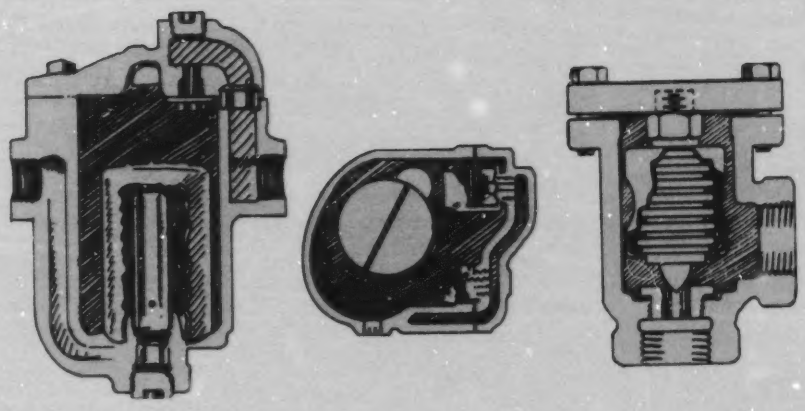


Figure 20-3—Inverted bucket trap (left); float and thermostatic trap (center); thermostatic trap (right).

Float and Thermostatic Traps

Generally, float and thermostatic traps (Figure 20-3) can be repaired without breaking the pipe connections. Remove the cap bolting and separate the cap, mechanism attached, from the trap body. Discard the old gasket and clean gasket surfaces. Clean dirt and scale from the bottom of the trap body.

Inspect all of the working parts for indications of wear or damage. The valve and seat may be worn or wire drawn (steam cut). Lever and pivot pin may be worn, preventing proper alignment of the valve and seat. The float may be collapsed or may have a pinhole leak. The thermostatic element may become misaligned, worn, or damaged. Check the castings for places worn thin by erosion. Replace any faulty parts with new ones. When the valve and seat are replaced, be sure to install the proper orifice size for the operating pressures. Be certain the lever moves freely and the valve seats tightly on the orifice.

Reassemble the trap, using a new gasket between the cap and body. Tighten bolts securely and restore the trap to service.

Thermostatic Traps

To inspect the thermostatic trap (Figure 20-3), open the trap body and inspect the thermostatic element. Bellows and diaphragm type units may rupture, collapse, or develop leaks. Bi-metallic units may break or corrode. As in all steam traps, the valve and seat may wear so that they do not close properly. When the trap is cold, the valve should be open.

Replace all worn or damaged parts, and reassemble the trap, using a new gasket.

Disc and Impulse Traps

Disc traps (Figure 20-4) are easily maintained be-

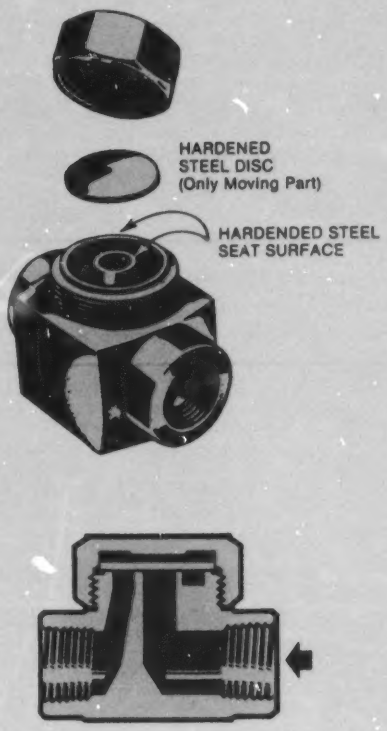


Figure 20-4—A disc trap shown in an exploded view (above) and cross-section view.

cause they have only one moving part and you can hear them "click" as they discharge condensate. Blowing problems are generally caused by dirt or scale caught between the seat and disc, which is easily removed when the cap is opened. The disc must be clean and feel smooth when rubbed against the seat.

Some types require the replacement of a pre-assembled cartridge. To repair them open the trap and remove the faulty trap element. Clean away the dirt and scale, making sure that metal-to-metal surfaces are clean and smooth. *Do not use gasket or pipe joint compound* on metal-to-metal sealing surfaces. If the body is wire-drawn where the cartridge seats off, it will not seal and the entire trap must be replaced. If the body is in good condition, install a new element and reassemble the trap.

Non-Repairable Traps

Some of the newer traps are made of stainless steel and are permanently sealed. If such a trap malfunctions, the problem may be dirt or scale lodged in the trap mechanism. Remove the trap from the line and back-flush the trap with water or compressed air. If there is a check valve in the trap inlet, be sure that it is blocked open during back-flushing. If the malfunction persists, replace the trap with a new one.

Energy Conservation

Because steam traps are relatively small, and are often located in out-of-the-way places, their importance is often underestimated. Steam traps are among the factors that determine the efficiency of heat exchange equipment. When steam traps fail to open, unit heaters and radiators become cold and will not heat. Also, steam mains may be improperly drained resulting in reduced steam flow through the main, wet steam, and water hammer. With condensate and air in a steam system, more steam is required to do the work. Excessive loads in some branches can upset the balance of a steam system.

When a steam trap fails to close, that one steam trap can waste more than 200,000 pounds of steam per month (figure based on a 3/8 inch orifice at low pressure). In terms of fuel, that amounts to some 1,900 gallons of fuel or its equivalent.

Annual Inspection

Steam traps should be included in the annual inspection of the heating and ventilating system. See the Annual Inspection Checklist in the Management Tools Appendix.

Additional Information

If additional information on the trap sizing is needed—orifice sizes for different pressure, maintenance instructions, parts identification, or application assistance—contact the manufacturer of the traps being used. The manufacturer is identified on the casting or on a tag affixed to the trap.

Valves

Valves control the flow of fluids. They start, stop, direct, regulate, or throttle the volume and rate of flow of water, steam, and gases. There is no universal type of valve to accomplish all these purposes, but there are six basic designs of manually operated valves usually found in schools. Each basic design has numerous modifications to meet special needs. Figures 20-5 through 20-11 illustrate the various valves and modifications found in schools. It is essential that the maintenance serviceman understand the mechanics of the particular valve under inspection or repair.

1) **Gate valves** (Figure 20-5) provide tight shut-off. They offer little obstruction to the flow of fluids, have little turbulence through the valve, and therefore, have very low pressure drop. They are used only in the wide open or full closed position.

2) **Globe valves** regulate or throttle the rate of flow (such as in a bypass around a pump regulator) or balance flow in several branch lines off a main line. Volume of flow is proportional to the turns of the handwheel.

A globe valve operates efficiently in any position, because it has a seating surface which minimizes seat erosion from the high velocity of fluid movement. (This erosion is called "wire drawing.") Figure 20-6 shows various types of globe valves.

3) **Butterfly valves** are used where both shut-off and throttling are needed with viscous fluids. They are not used on steam or gases. Since butterfly valves fit between companion flanges, they cannot be removed for repair without upstream

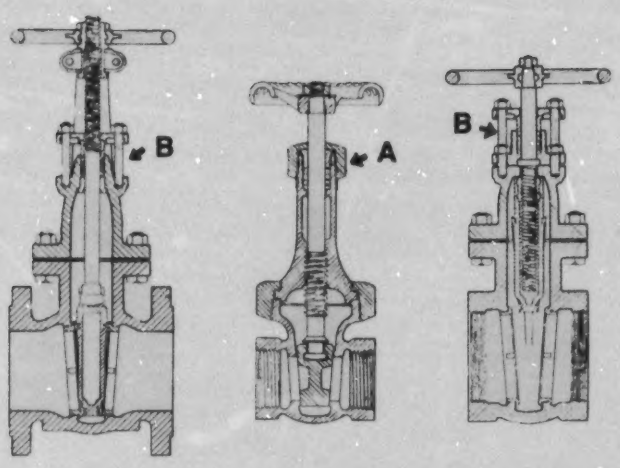


Figure 20-5—Gate valves. O S & Y stem design (left); inside screw, rising stem design (center); inside screw, non-rising stem design (right).

shut-off unless double lug valves are provided. Figure 20-7 shows a typical butterfly valve.

4) Ball valves (Figure 20-8) are a more modern type used to perform the same function as globe valves. This valve has a rotating ball with a hole through it that allows straight-through flow in the open position and shuts off flow when the ball is rotated 90 degrees to block passage. It requires only a quarter turn from open to closed while the globe valve requires multiple turns.

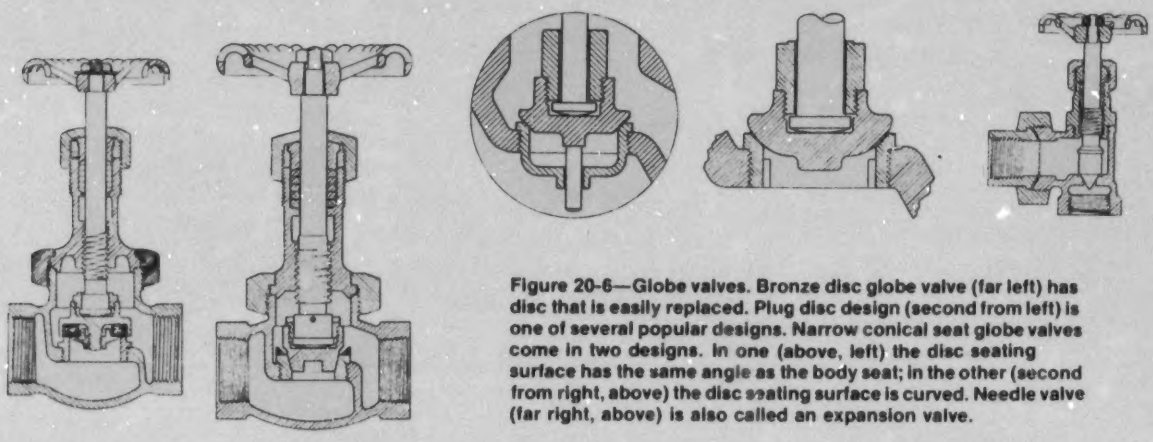


Figure 20-6—Globe valves. Bronze disc globe valve (far left) has disc that is easily replaced. Plug disc design (second from left) is one of several popular designs. Narrow conical seat globe valves come in two designs. In one (above, left) the disc seating surface has the same angle as the body seat; in the other (second from right, above) the disc seating surface is curved. Needle valve (far right, above) is also called an expansion valve.

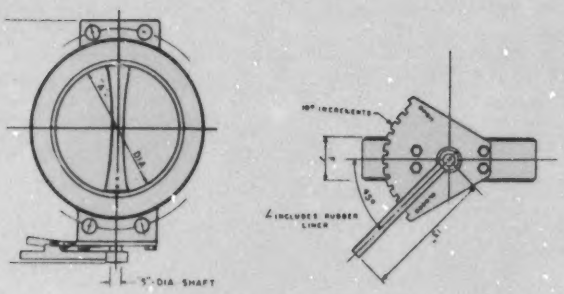


Figure 20-7—Butterfly valve.

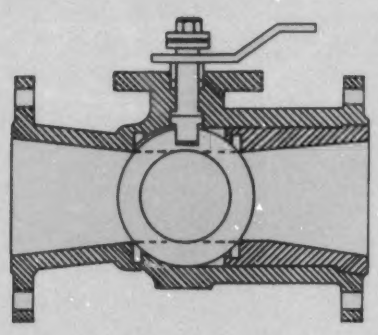


Figure 20-8—Ball valve. The outer circle in the center of the valve is the ball and the inner circle is the hole opening. Valve is shown in closed position. Dashed lines show ball rotated 90° to open position.

5) Check valves are used to prevent the reversal of flow in a line. They represent safety or precautionary devices. The pressure of the flowing fluid keeps the valve open. The differential pressure on flow reversal closes the valve automatically, and tightness of seat depends upon how high the back pressure is. Figure 20-9 shows various types of check valves.

A special check valve often found in schools is the boiler stop check valve. The valve shown in Figure 20-10 is a globe pattern, but the stop-check valve also is common in an angle pattern. It is a combination of a lift-check and globe valve. As shown in Figure 20-10 the stem is not attached to the disc, and is used only to close the valve when required for boiler testing or shutdown.

6) Cocks and plug valves were probably the first valves known to man. Because of their simplicity and low cost, they find widespread use in shutting off or transferring water, oil, air, and gas. Figure 20-11 shows two common types.

In addition to manually operated valves, most schools will have some type of automatically controlled valves for the environmental temperature control system. These control valves are special modifications of (but similar to) globe, ball or butterfly valves with automatic actuators. The actuators have one of five motive forces:

1) Pneumatic or air operated actuators are either diaphram, bellows or piston operated, usually with air at a maximum of 15 pounds per square inch.

2) Electric motor operated actuators are either cam operated uni-directional or reversing motors with a gear train. A release mechanism and spring return must be used if the valve is to be returned to a preselected open or closed position on power failure.

3) Self-actuated control valves have a remote, temperature-sensitive bulb or element connected by a capillary or hollow metal tube to a diaphragm or piston operator. The element and capillary are sealed and filled with a fluid or vapor which expands when heated, creating a pressure which operates the actuator to open or close the valve.

4) Solenoid operated valves have a coil of wire surrounding the valve stem. When electric power is applied to the coil a magnetic field is created which raises the valve stem similar to a magnet pulling a nail to it. The magnetic power generated is limited by the size of the coil, so this type of valve is used

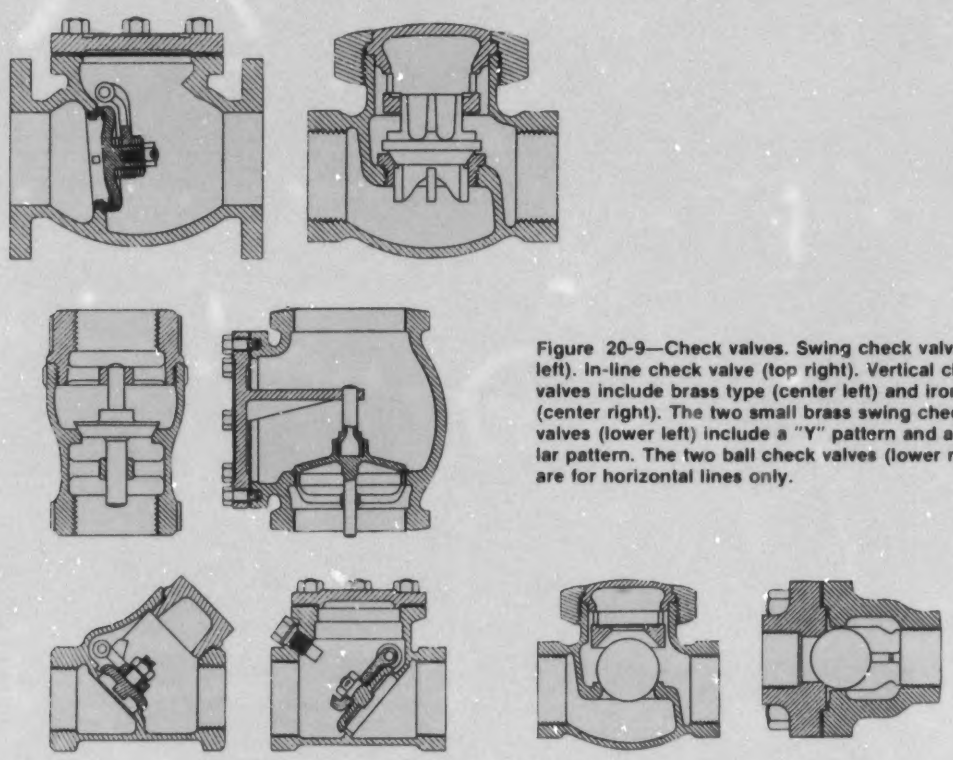


Figure 20-9—Check valves. Swing check valve (top left). In-line check valve (top right). Vertical check valves include brass type (center left) and iron body (center right). The two small brass swing check valves (lower left) include a "Y" pattern and a regular pattern. The two ball check valves (lower right) are for horizontal lines only.

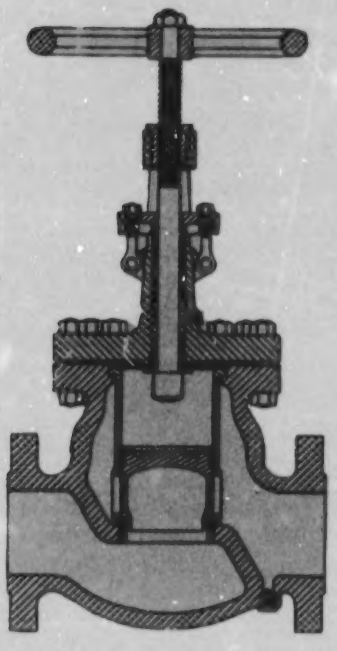


Figure 20-10—Stop-check valve is found in several patterns on school boilers.

only for open-closed operation in smaller sizes normally under 1½ inch pipe size.

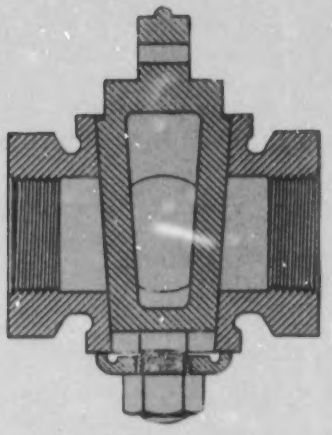
5) A not-too-common type is the hydraulically actuated valve that has a viscous fluid and small pump in a sealed system. The valve will open, close and some types will modulate or throttle when the electric motor on the pump is energized. These valves require a great deal of maintenance and are difficult to service and therefore are not too popular.

VALVE MAINTENANCE AND CARE

With minimum maintenance effort, thousands of dollars in valve replacement can be saved each year. Most manual valves need to operate only in emergencies. A little care will ensure proper operation when desperately needed.

Leaking is the major problem encountered with valves. A valve can leak internally by not shutting off completely when required. More commonly, valves leak externally at various connections, such as where the pipe joins the valve or flange, around the stuffing box, or where the body and bonnet connect. Frequent and regular inspection, therefore, is the best valve maintenance. When a leak is found, it should be corrected immediately, as time will only make it worse, not better.

In most cases, external leaking can be corrected by tightening the flange bolts or stuffing box nut. Be sure to use the proper type and size wrenches to



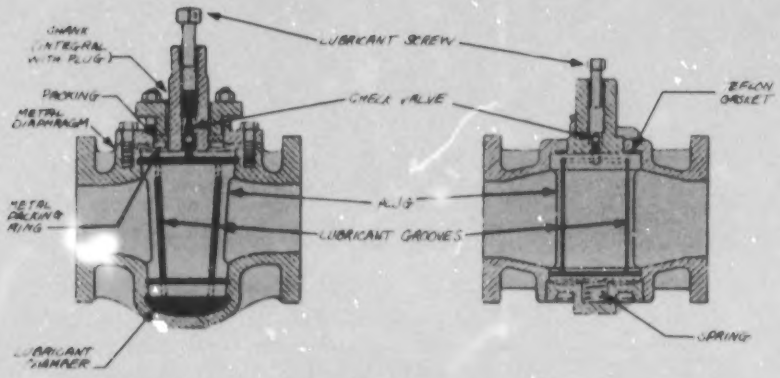


Figure 20-11—Plug cock valve (left) is of simple straight-way design and shown in closed position. Two typical designs for lubricated plug valves (below) include one with conical shaped plug (lower left) and one with a cylindrical plug.

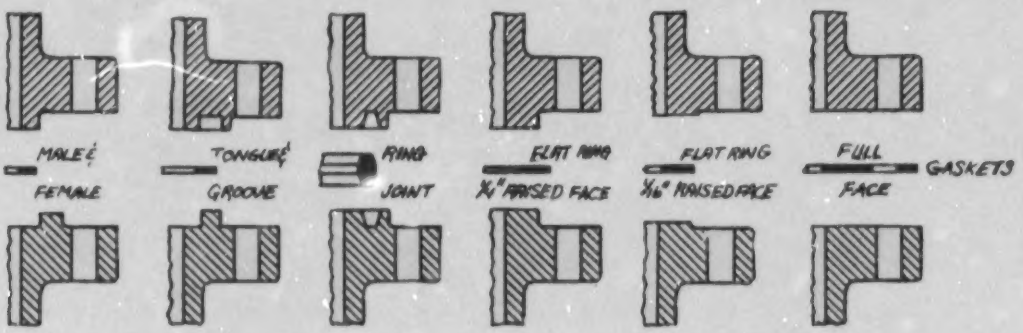


Figure 20-12—Flange facings come in several standard types with corresponding gaskets.

fit the job. Excessive torque at the wrong point can result in problems greater than the original leak. When tightening the packing gland nuts (hex nut at **A** in Figure 20-5—center—just below the handwheel, or bolts at **B** on top flange just below the handwheel in Figure 20-5—right), the valve stem should be moved up and down a little first to free the stem from the packing material. Next, tighten down the stuffing box with enough pressure to make stem movement difficult. Then loosen the packing nut so it is free and tighten it down again only finger tight. Finally, move the stem up and down again and tighten further only as required to stop leaking.

Caution: When opening a closed valve, do it slowly. Surge pressure or rapid temperature change can easily damage piping or equipment downstream of the valve.

If proper tightening fails to correct the leak, the only solution is to replace the flange gaskets or the stem packing.

Replacing Gaskets

The use of proper gaskets is the answer to maintaining tight flange joints. The gaskets must properly match the flanges and must be suitable for the fluid carried in the line. There are numerous types of flange faces used for as many different applications. The gasket must match the type of flange face. (See Figure 20-12 for various types of flange faces and gaskets. Some of these are common in schools; some are not.)

Probably the most common type used in schools is the plain (flat) face flange used on brass, bronze, and 125-pound cast iron valves. The gaskets for these flanges should always be full faced and nonmetal, because any gasket with a inside diameter less than that of the flange may produce excessive bolting load on the flange metal. With a narrow gasket, the flange has an open space beyond the outside edge of the gasket. This causes the flange to assume the functions of a cantilever (Figure 20-13). Non-metal gaskets are preferred for these conditions, because they require less unit loading to make a tight joint than do metal gaskets.

When opening or tightening the bolts on a flanged joint, the nuts directly across from each other should be loosened or tightened in sequence similar to the method used to tighten the lug nuts on an automobile wheel.

Before installing new gaskets be certain that the flange faces are thoroughly cleaned and polished and that the gasket is properly aligned on the flange face.

Questions about flanges or gaskets should be referred to the supply house or contractor.

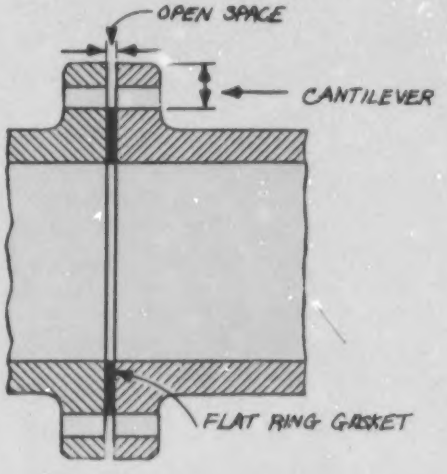


Figure 20-13—Narrow gasket shown here can produce undue stress on flange. Gaskets, therefore, should always cover the full face of the flange.

Repacking Stuffing Boxes

A leaky stuffing box may be caused by a loose nut, worn out packing, or a corroded stem.

Most valves are designed with a back-seating arrangement that temporarily holds back the fluid while repacking. After the old packing is removed, check the valve stem to be sure it is smooth and polished. If it is pitted, probably no amount of stuffing box tightening will stop the leak. Thus, it is necessary to shut down and repair the valve.

The stuffing box must be cleaned before installing the new packing. The packing should be of material recommended for the service. The most common types are graphite string or ribbon or nylon or teflon in either ribbon or formed pieces. After the new packing is in place, tighten down the stuffing box nut and follow the procedure mentioned earlier for tightening nuts in the proper sequence.

Both manually operated and automatically actuated valves have similar packing arrangements, but the packing is much more critical in an automatic valve to insure proper operation. Unless maintenance personnel are familiar with the automatic valve, any service may be best left to the manufacturer's service department.

Replacing Worn Discs

When the valve does not shut off completely, the disc should be checked and replaced if worn. To check the disc, turn the stem to the closed position, open the bonnet joint where the stuffing box and stem assembly join the valve body, and lift out the entire assembly. Check the valve seat in the body for smoothness.

To replace the disc, remove the retaining nut and install the new disc. The disc must be of proper composition for the type and temperature of fluid. Note also that the stem is attached to the disc holder by means of a slight swivel. This action is required to allow the disc to properly seat.

It is recommended that only trained personnel replace discs or seats in automatic control valves.

Lubrication

Proper lubrication can prevent a number of valve problems. A routine schedule is best, but a haphazard program is better than none at all. Stem lubrication with a mixture of oil and graphite should be applied just above the stuffing box. The schedule required will depend on how often the valve is operated and what fluid it is controlling. A frozen valve stem indicates a lack of lubrication. Some valves have oil holes in the yoke cap, some have grease gun fittings, and others have stick lubricant chambers. Records of the various types, along with locations and code tags should be assembled as a means of scheduling inspections and maintenance. Such planning prevents delays in repairing valves and helps in stocking parts.

Any problem that appears to be beyond the scope of the maintenance team should be referred to the contractor, plumbing-heating supply house, or valve manufacturer.

Annual Inspection

Valves should be included in the annual inspection of the heating and ventilating system. See the Annual Inspection Checklist in the Management Tools Appendix.

Unit Heaters

A unit heater consists of a fan and motor, a heating element, an enclosure or cabinet, and a directional outlet. There are three main types of unit heaters: (1) Horizontal Propeller Fan, (2) Vertical Propeller Fan, (3) Cabinet Type Centrifugal Fan. The cabinet type unit may be arranged to deliver air horizontally or vertically.

The heating medium can be steam, hot water, gas, or electricity. If they become inoperative, gas fired (natural gas) and electric unit heaters should be serviced by either a qualified service organization or by the local utility company.

Unit heaters all operate on the same general principle. A room thermostat turns the motor on. The motor turns if the heating element is hot. When the thermostat is satisfied, it shuts the motor off. Some units are installed with a "summer-winter" switch mounted with the thermostat. When set in the summer position, the unit can be operated without the heating element being hot. This is used for air circulation when the heat is not required. On steam or hot water units, a return line aquastat is wired in so that the motor will not run until the aquastat is satisfied. The "summer"

switch cuts out this controller.

With gas fired unit heaters, the burner is ignited and the heat exchanger allowed to get hot before the fan motor comes on. When the room thermostat is satisfied, it shuts off the gas valve while the motor continues to run until the heat exchanger cools off. Then the motor is stopped. The electric unit heater operates in a similar manner in that the coil is turned on before the fan motor starts, and again is turned off before the fan motor is stopped. The table below presents a suggested maintenance schedule for unit heaters.

GENERAL CLEANING

General cleaning is a most important factor in trouble-free and economical operation. The location of a unit is important to its cleaning schedule. A horizontal unit in a woodworking shop will require cleaning more often than will the same unit hanging in a clean storage room.

The heating element of a unit heater must be kept clean. The greatest amount of dirt, lint, sawdust, or other particles will be on the air entering side of the heating element. A good brushing will loosen most of the dirt. (Be sure to protect the motor from the dirt.) Do not remove a gas fired or electric heating element from a unit. Call a serviceman for this kind of work.

Inspect the fan for dirt. The fan can be cleaned by brushing; if very dirty, the fan can be washed but remove it from the motor shaft first. When replacing a fan on the motor shaft, or just inspecting it, pay particular attention to tightening the set screws. These screws should seat on the flat or keyway of the motor shaft.

After oiling the motor, wipe up all excess oil. This will help keep both the motor and the fan clean. Oil left on the motor rapidly collects an insulating coat of dirt, which causes the motor to heat up and shorten its life.

During general inspection, check the unit casing. Tighten loose nuts and bolts. Make sure electrical connections are tight and not rattling against the unit casing. If the casing shows signs of rust, scrape the spots clean and retouch with paint.

The exterior surfaces of the unit should be cleaned the same as polished furniture.

Maintenance Schedule for Unit Heaters

Quarterly

1) Oil motors on units that run constantly.
2) Check filters; replace or clean dirty filters.

Semi-Annually

1) Oil motors on units that operate intermittently.

Annually

1) Clean entire interior of cabinet.
2) Clean heating elements as necessary.
3) Include unit heaters in annual inspection. See Heating and Ventilating Systems Inspection Checklist in the Managment Tools Appendix.
4) Inspect for proper operation of controls.
5) Inspect traps on steam units.

FILTERS

Most cabinet units have a filter rack built into the cabinet. Filters are installed to take the dust, lint, and dirt out of the air before it enters the coil. A dirty filter, just like a dirty coil, greatly reduces the air delivery of a unit heater and, therefore, reduces the heating ability of the unit. Dirty filters and/or coils are the major cause of service calls complaining of "no heat."

LUBRICATION

Sleeve bearing motors are wool packed, oil lubricated bearings. SAE 20 grade oil is recommended for oiling these bearings. A few drops of oil about three times a year will keep these motors in fine running shape. *Do not over oil.* Wipe up all spillage. The cabinet type unit heater also uses sleeve bearings on the fan shaft. These bearings should be oiled at the same time with the same type oil. When oiling these units, be careful not to get any oil on the belt drive. If this should happen, wipe it up immediately.

Ball bearing motors should be greased about twice a year. Note that the plugs should be removed from the bottom of each bearing before supplying grease through a zerk fitting or grease plug. If the bottom plug is not removed, grease will be forced through the bearing into the motor winding. Remove surplus grease and replace grease plugs. Grease used on vertical unit heaters should be of the high temperature type recommended by the motor manufacturer.

ORDERING PARTS

Be prepared to give a complete model number of the unit from the unit heater nameplate when you call or write the manufacturer or your heating supply distributor. In addition, when ordering motors, obtain both *unit and motor* nameplate data. This will lessen the chance of part selection error and

eliminate extra phone calls. A typical unit heater model number will include a letter or series of letters followed by a series of numerals.

ENERGY CONSERVATION STEPS

1) Clean filters and elements are essential to proper energy conservation and comfortable conditions.

2) On steam units, a seemingly "tiny" amount of dripping or poor trap operation can amount to dollars per year *per unit*. Repair or replace traps as required. See "Steam Traps" on page 142.

3) Improper burner operation on gas fired units also contribute to energy waste. Have a local service contractor check all gas appliances on the first hint of malfunction.

4) Proper control function is necessary for maximum energy conservation on all types of unit heaters. See "Temperature Controls" on page 160.

5) Since most unit heaters do not directly use outdoor air, reduced thermostat settings will provide considerable energy savings and are recommended at all times.

Unit Ventilators

Unit ventilators can heat, ventilate, or air condition. All unit ventilators make use of outdoor air whenever practical to achieve proper comfort conditions. They provide a minimum amount of outdoor air during occupied periods to meet health code requirements. Greater than minimum amounts are provided during those periods when natural atmospheric "free cooling" can overcome internal heat gains within a room when those heat gains are in excess of heat loss.

There are three basic types of unit ventilators: standard heating and ventilating; heat, ventilating and air conditioning; and heat pump type heating, ventilating and air conditioning.

A unit ventilator will heat an area to a desired temperature as called for by the room thermostat and will maintain that temperature by allowing outdoor air and/or recirculated room air to discharge into the room. This is done by means of dampers and/or valves. The required temperature is maintained by the room thermostat and an air stream thermostat. One works with the other to keep the discharge air coming out of the unit ventilator at such a temperature that the room air will remain at the constant temperature called for by the room thermostat.

At startup time in the morning, the discharge air coming out of the unit ventilator will be hot in order to bring the room air up to the desired temperature. As soon as the room is occupied, the temperature of the discharge air will go down to a point sufficient to take care of the heat loss of the room. After the room has been occupied for a time, the discharge temperature generally drops below the thermostat setting, because the combined heat given off by the students, the lights, and the sun is more than the heat loss of the room. To maintain the desired temperature, it is therefore necessary to provide cooling by introducing outside air. This is done by means of dampers and/or valves in the unit ventilator.

HEATING SYSTEMS

There are five basic types of heating systems available for use with unit ventilators: steam, hot water, gas (direct fired), electric, and heat pump (water or air source).

Steam unit ventilators are controlled by a valve on the heating coil supply line and damper motors on the outdoor air and return air dampers. The steam unit ventilator has a trap on the return line of the coil. This is either a thermostatic trap or a larger float and thermostatic trap.

Hot water unit ventilators are divided into two classes: valve controlled and damper controlled. The valve controlled unit has a supply valve similar to the steam unit. It also has a single damper motor operating the outdoor air and return air dampers. The control valve generally is a three-way valve that, when closed, bypasses water around the coil. The damper controlled unit generally does not have a control valve. It has a third damper inside the unit, which is called a bypass damper. The coil has water circulating through it at all times, and temperature control of the discharge air is accomplished by movement of the bypass damper. This allows the proper percentage of air to go through the coil while the balance of the air bypasses the coil. When mixed, this air is then

at the proper temperature for the desired room condition.

Gas fired units were used when a central heating plant was undesirable or unavailable. These units are no longer manufactured. These units were equipped with outdoor air and return air dampers. Combustion air came from the room or from an outside inlet. In some buildings, a unit was installed in each room; in others, a small furnace room serviced two adjoining rooms. The operation and control of these units is similar to the steam unit except that in place of the coil, there is a heat exchanger with a gas burner that goes on or off to maintain room temperature.

Electric unit ventilators are becoming more common. The basic operation is similar to the steam unit, except that an electric coil controlled by a step controller is used in place of a steam coil. The individual elements of the electric coil come on in steps. For partial heating, therefore, only part of the elements are used.

Heat pump unit ventilators are divided into two classes: water source and air source. Both classes use a complete refrigeration circuit involving two coils and a reversing valve which controls the function of each coil. The water source type has a water-to-refrigerant heat exchanger coil which, in the heating mode, functions as an evaporator. The room side air coil functions as the condenser in the heating mode. The air source type uses an outside air-to-refrigerant coil which, in the heating mode, functions as an evaporator. Again the room side air coil functions in the heating mode as the condenser. The air source type usually is furnished with an auxiliary electric heat coil. Both use outdoor and return air dampers in a similar fashion to the steam type described earlier. The water source type shares a common pipe loop with all the other units in the building with the pipe loop and optional storage tank serving as a "heat sink." Air source types are usually self-contained. Solar assist can be added in some cases to water source heat pump systems.

AIR CONDITIONING SYSTEMS

Two basic types of air conditioning are found in unit ventilators: direct expansion and chilled water. Both types may occasionally be found in a "future" configuration where provisions for adding air conditioning at a later date were made at the time of original installation (generally in newer buildings only). Both types include insulation and a drain pan which is piped to a condensate disposal system.

Direct expansion type units are further divided into three classes: remote condenser class (split system) uses a small two to five ton condenser located outside near the unit ventilator it serves. The self contained class uses a completely self contained system within a single unit ventilator cabinet and must be located on an outside wall. The heat pump class is the same unit as described under heating systems. The heat pump reverses the function of the two coils in the air conditioning mode from that described in the heating section through the use of a reversing valve. All direct expansion type units do not require a seasonal changeover and therefore have exact comfort conditions available at all times.

Chilled water type air conditioning units are available in two classes: two pipe and four pipe.

Maintenance Schedule for Unit Ventilators

Caution: Gas fired burners, electric elements, temperature controls, and refrigeration systems (chiller or direct expansion) should be serviced only by competent individuals trained to work on those systems.

Monthly

1) Listen for unusual motor or drive noises that would indicate a bearing problem.
2) Check filters; clean or replace as necessary. Make sure to clean both filters if two are used. Second filter will be behind the first one and may not be easily visible.
3) Inspect wall intake box to see that it is free of leaves and debris.

Semi-Annually

1) Inspect interior of the unit and clean as needed. Pay particular attention to entering air face of heating/cooling coil for dirt or lint.
2) Check damper linkages and control mountings to insure proper positioning and alignment. See that the outside air damper closes properly and seals tightly.
3) Inspect belts if the unit is belt driven. Replace belts if badly frayed or cracked. Check alignment of the drive.
4) Lubricate motors and fan shafts as indicated on the unit nameplate.
5) Inspect traps and control components for proper operation.

Annually

Include unit ventilators in an annual equipment inspection. See the Heating and Ventilating Systems Inspection Checklist in the Management Tools Appendix.

Both use a piped central chiller plant with accompanying air cooled condenser or evaporative cooling tower. The two-pipe version uses the same coil as described under the "hot water-damper controlled" section except that the coil is usually larger. (See energy conservation suggestions.) The water must be seasonally changed over from heating to cooling and back when the weather changes. Four-pipe units use separate heating and cooling elements. The heating elements will be hot water, steam, or electric. The cooling is a separate chilled water coil. Each hot water or steam unit, then, has two supply pipes and two return pipes—thus, four pipes. Seasonal changeover is not necessary with four-pipe units.

FILTERS

Filters take dust and dirt out of the air before it enters the coil of the unit ventilator. Dirty filters greatly reduce air delivery and restrict the heating and cooling capacities of the unit.

Important: Units with direct expansion cooling coils must not be operated with dirty filters. Low air flow over a direct expansion coil can result in compressor failure.

A filter cleaning schedule should be based on experience for each room. A ground floor room near a playground area will require more changes or cleaning than will a similar room on an unused lawn area. Upper stories of a building generally do not require the frequency of service that is necessary for ground floor or basement rooms. A kindergarten room becomes loaded with lint more rapidly than any other room, due mainly to the rugs used by the small children. Filters become plugged more rapidly during the winter months than during the fall and spring seasons, because of lint from winter clothing. Therefore, individual room use, location, and season are the determining factors in the filter cleaning schedule.

Some unit ventilators use only one filter to clean all the air going through the unit. Other units have split filters, both in length and width. Large air handling units use a multitude of square filters. When the filter is long and very narrow, one filter is usually in a separate rack behind the other. If a filter is about six inches wide, there usually is another filter behind it. Do not miss cleaning or replacing this second filter.

There are three main types of filters available: the permanent type, the replaceable or throwaway type, and the renewable media filter.

A permanent filter has a metal frame with a crimped metal filter. To clean a permanent filter, immerse it in a scalding cleaning solution and move it up and down rapidly to wash out the dirt and oil. A good cleaning solution can be made by dissolving 1-1/2 pounds of washing soda in 10 gallons of hot water. If a cleaning tank is used, there should be a false louvered bottom to prevent stirring up the settled dirt on the bottom of the tank. After the filters are cleaned, they should drain dry. They must be sprayed thoroughly or dipped with filter oil until the filter is coated all the way through. After oiling, the filter is racked over a drain pan for at least 12 hours to allow the excess oil to drain off. It is advisable to have extra filter cells of all required sizes so that some can be cleaned while the others are in service.

Replaceable or throwaway filters are made of spun glass interiors with a cardboard frame. After this type of filter has become dirty, it should be thrown away and replaced with a new filter. Cleaning the surface with a brush or broom does not clean this filter, nor will pounding it get out enough dirt. Some dirt, of course, will come out, but the oils on the glass media have already been soaked up and dirt will now pass through this "cleaned" filter. Enough throwaway filters of all required sizes should be stocked to make sure clean ones are available.

Renewable media filters are a combination of the best features of permanent filters and replaceable filters. They have a metal suitcase-type frame and use spun glass for the filtering media. The renewable filtering media is purchased in a 75-foot roll of the desired width. This media is compressed in a box so that a roll of media is approximately a 14-inch cube. The spun glass filtering media is pulled from the box and cut off to proper length with an ordinary pair of scissors. The media is pre-oiled so no further oiling is necessary.

LUBRICATION

Oil sleeve bearings twice a year using SAE 20 oil. Grease ball bearings once a year through the zerk fitting or plug on the outside of each bearing. Over greasing will force the lubricant through the bearing, where it may be picked up by the fan and discharged into the room.

Belt tension should be adjusted if required. The belt should be just tight enough so that it does not slip, but not so tight that it causes excessive strain on motor or fan shaft bearings. If the belt becomes frayed or noisy, it should be replaced at once. Do not try to tighten a loose belt by closing the adjustable motor sheave. This will speed up the fan and cause noise.

INSPECTION

Some unit ventilators are furnished with a separate fusetron in the unit switch box, or it may be found in a separate box near the electric outlet box in the unit. The types and sizes of these fuses should be recorded and a small quantity of each size and type should be stocked.

If belt drive units are used, the belt sizes should be recorded and at least one of each size should be stocked. A belt that has remained in one position for some time may develop a hump and become noisy. For this reason, during extended shutdown periods, it is well to run all belt drive units once a month for a few minutes. This is especially important if the belt is very tight. Make sure that no oil from the motor or bearings gets on the belt. If it does, wipe it off immediately. Oil will ruin a belt.

If direct drive units are installed, couplings and bearings could be required. Since any given manufacturer standardizes on these items, all couplings and bearings in a classroom unit are identical on all size units of one manufacturer. Two of each should be stocked.

All unit ventilators use some type of special wrench, key or screw driver fastener to keep them tamperproof. It is recommended that two complete sets of these tools and fasteners be obtained, one set for the heat custodian and one set for the school's administrative office. If the custodian is not available, the office set will be available for emergency use. These special tools may be obtained directly from the unit manufacturer.

Do not, under any circumstances, try to oil the damper motors, valve stems or thermostats. If there is a malfunction in these parts, call the temperature control serviceman.

RECORDS

A complete set of records should be kept on each unit ventilator. If the building is comparatively new, obtain a set of "shop drawings" from the architect or heating contractor. These drawings give all pertinent information on each unit by room number. If shop drawings are not available, most manufacturers can furnish a file print for each unit—if the building is not too old. The only other alternative is to take a physical inventory and record the following:

Manufacturer _____
Model Number _____
Serial Number _____
Current _____
Motor Shaft Sizes _____
Room Number _____
Date Installed _____
Belt Size _____
Motor Frame Number _____
Fan _____
Bearing Size _____
Outside Service Information _____
Fuses _____
Coupling Size _____

ORDERING PARTS

Always be prepared to give a complete model and serial number of the unit ventilator off of the nameplate when you call or write the manufacturer or your heating supplies distributor. In addition, when ordering motors, obtain both the unit and motor nameplate data. When ordering coils, be sure to specify whether coil is hot water or steam. Some buildings have been changed over from steam to hot water and the original unit model number alone may not give the proper coil selection. A typical unit model number will include a letter or series of letters followed by a series of numerals. This information will lessen the chance of part selection error and eliminate extra phone calls, thus speeding up part delivery. Requests for temperature control component parts should be directed to the temperature control contractor, not the unit manufacturer (unless supplied by unit manufacturer).

ENERGY CONSERVATION

1) Clean units and regularly changed filters are essential for proper temperature control and result in less energy consumption.

2) When conditions permit, low speed fan operation saves energy *except* on heat pumps and on direct expansion cooling operation. Low speed usually *increases* consumption during heat pump or direct expansion cooling operation.

3) A seemingly tiny amount of dripping or poor trap operation on steam units can amount to dollars per year per unit. Repair or replace traps as required.

4) Improper burner operation on gas fired units can similarly add up in decreased-fuel efficiency. Have a service contractor or local utility check all gas appliances immediately on the first hint of malfunction.

5) Check all temperature control devices for proper calibration periodically. Overheated rooms are the largest energy wasters. Overheating is possible on damper controlled units when hot water/outdoor air reset is not functioning properly or not used. Reset should be investigated for use on "moderate" days if you are experiencing overheating with all other components functioning properly.

6) If your building was designed prior to 1974, chances are that some "minimum" outdoor air quantities can be adjusted downward. Contact

your consulting engineer or temperature control contractor.

7) Reduced thermostat settings (65 degrees in winter, 78 degrees in summer) save energy in unit ventilator systems during summer months and most severe winter months. However, during "moderate" days, generally between 30 and 70 degrees during spring and fall months, these settings do not save energy. In certain cases, they may actually waste energy. Common sense is a good rule. When it's below freezing outside and cloudy, a 65 degree set point will save energy. The same goes for a 90 degree summer day and a 78 degree set point. However, when it's 60 degrees outside, a 65 degree setting will force a slightly less comfortable condition than would 72 degrees, and may even bring on cooling, depending on the internal heat gain in the room, which would cause additional unnecessary energy usage. A similar situation could be described for the higher set point. So the best suggestion for thermostat settings is reduce when possible, but use good common sense.

8) All direct expansion type cooling units should have a low ambient lockout set at 55 to 60 degrees. On those rare "recirculation only" type units (no outdoor air) and others, this may not be installed. Check with your consulting engineer or temperature control contractor.

9) When coil freeze occurs, two things are wrong: below freezing air and no flow (of water or condensate) are present. *Both* should be addressed and corrected. Freeze-up *cannot* occur without both. Check for poor damper seals, damper motors and leaks around unit. Check also for obstructions to proper water condensate flow.

10) Since most classrooms are occupied only about 15 percent of the 8,760 hours in each year, a night setback or "unoccupied" control sequence should be employed with unit ventilator systems. If you do not have one, contact your consulting engineer or temperature control contractor.

Air Handling Units

An air handling unit generally consists of a centifugal fan, heating and/or cooling coils, filter box, fan motor, and belt drive. It may be controlled by cycling the fan from the thermostat or the fan may run continuously with heating/cooling capacity modulated by face and bypass dampers or a valve control on the heating/cooling medium. The fan section may discharge into conventional ductwork or into a plenum with grilles.

The table at right presents a suggested schedule of preventive maintenance for air handling units.

Spare belts should be stocked. If drives are multiple belts, the belts should be stocked in matched sets and the complete set of belts replaced at one

Maintenance Schedule for Air Handling Units

Weekly

Observe unit in operation. Listen for unusual motor or drive noise. Look for any unusual leakage from any part of unit cabinet.

Quarterly

1) Lubricate fan motor as recommended on nameplate.
2) Lubricate fan shaft bearings as recommended. In the absence of specific instructions, lubricate quarterly.
3) Remove the belt guard and check condition of belts; replace as necessary. Adjust drive tension quarterly, even if belts are not replaced. Check belt alignment.
4) Check filters; replace or clean as required.

Annually

1) Inspect the entire unit—tighten loose bolts, linkages, and the like. See the Heating and Ventilating Systems Inspection Checklist in the Management Tools Appendix.
2) Check end play on fan shaft and adjust if excessive.
3) If access is available, check that dampers are properly aligned and seating tightly.
4) Inspect entering air face of heating/cooling coils to see if there is an accumulation of dirt, lint, or grease. Clean as required.

time. If belt life is shorter than expected, recheck alignment and tension. It is normal for belts to squeal on startup; do not overtighten just to eliminate this initial squealing.

When checking or servicing motors, drives, or fan wheels, be sure the motor disconnect is open and tagged so other personnel will not restart the unit. Be careful near belt drives when belt guard is removed for service. Do not wear loose clothing or neckties when working near exposed drives.

Air handling units often draw in large quantities of outside air. The amount of outside air depends upon the adjustment and alignment of the outside air dampers. Insure that these dampers close and seat properly, so that excess outside air quantities are not heated and cooled due to improper damper adjustment or leakage.

Rooftop Air Conditioning

Rooftop air conditioning equipment consists of a complete package containing both heating and cooling facilities. The package may be a single-zone system serving only one area, or a multi-zone system serving several areas at the same time. The major cooling components are the refrigeration compressor, evaporator or cooling coil, and air cooled condenser coil. The heating sections vary depending upon the heat source—gas, oil, or electricity. Some units may use hot water or steam piped from a central boiler.

Each manufacturer has specific instructions on how to adjust and care for the various components of the equipment. Special tools and training are necessary in order to make certain repairs and to perform certain maintenance checks. However, most of the important checks and maintenance services should be made regularly by the school maintenance team. All that is required is alertness during specific routine inspections. The Maintenance Checklist for Rooftop Air Conditioning in the Management Tools Appendix will help in scheduling and carrying out the maintenance program. The following is what can and should be done on a routine basis.

WEEKLY

Allow about 15 minutes to inspect each unit as follows:

1) **Check the room thermostats** to make sure they respond to the call for heating or cooling, and that they maintain the set point temperature. Replace or calibrate thermostats as necessary.

2) **Observe operation of all fans** on the rooftop unit. Some units have three fan sections for supply air, return air, and condenser.

- Listen for fan noises. Most fan noises will be the result of worn or defective belts or bearings. Fan belts should slip on startup for approximately 30 seconds. If they continue to slip after the motor comes up to speed, the belts or pulleys need to be checked.
- Fan vibration also may be due to out-of-balance. Check fan wheels to make sure they are free of debris.

3) **Observe the evaporator coil section.**

- Make sure all filters are clean and in place.
- Look at fan inlets to be sure nothing is blocking air flow; sometimes loose insulation or paper will find its way into the inlet.
- Observe the refrigerant sight glass. It should be clear and free of bubbles.
- Check to make sure the drain in the pan below the coil is free and draining condensate.

4) **Observe the condenser coil section.**

- Make sure that the fan discharge protection guards are in place and that there are no sticks, wires, or the like lodged in the guards which could strike the fan blades.
- Check fan blades for damage.
- Check the coil face for dirt, leaves, etc. This is especially important when cottonwood or sycamore trees are shedding. This shedding will quickly plug a condenser.

5) **Observe the refrigeration compressor.**

- Check the oil sight glass. Oil should be visible in the glass, but not necessarily full; this level will change depending on unit load.
- When the compressor is running, the suction side should be cool to the touch and may be sweating. If it is warm or if there is ice on the suction line, then something is wrong.
- Do not touch the discharge line; this often will run quite hot and could cause a painful burn.
- Observe the compressor to make sure it is not short cycling. If it starts and stops more than

once every 15 minutes, something is wrong.

• Observe refrigerant piping for obvious leaks. A bad leak leaves an oil residue around the piping.

• Inspect the compressor electrical control panel. Listen to make sure contactors are not chattering. Look for moisture which might get in through leaking door gaskets. Observe the condition of control wires. If wires are loose, they will overheat. *Do not touch any wires or controls while panel is energized.*

6) Observe the heating section.

• Check the flue vent on oil and gas fired units to make sure they are not blocked or rusted out. Excessive carbon in this area indicates improper burner adjustment.

• Check the burner section on oil and gas fired units to make sure there is no evidence of flame leakage in this area. This could result if the burner door gaskets are leaking or if the burner is not properly adjusted.

• Listen to burner operation. The flame ignition should be smooth. Rumbling or loping indicates improper burner adjustment. Delayed ignition will result in a noisy light off. Delay also indicates a need for burner adjustment.

• Examine the electrical control panel on units with electric heat. Listen for chattering heating contactors on each heater. Watch for short cycling which will be evident by a heating relay pulling in and out every few seconds. Look for loose wires in the panel. This will be evident by wires which appear to be burned. *Do not touch any wires or controls while panel is energized.*

MONTHLY

Allow about 30 minutes to inspect each unit, as follows:

1) Adjust fan belts on all fans.

2) Clean or change filter as necessary.

3) Clean evaporator coil if necessary. This will probably be necessary only once a year, depending on filter maintenance. Do this with a brush and vacuum cleaner, or a hose and cold water. *Do not use hot water.*

4) Clean the condenser coil. If necessary, do this two or three times during the cooling season. This will depend on the area and how many seed-shedding trees are nearby. If there are many units, it will save money to purchase a portable high pressure washer with a fine spray attachment. These are used with a mild soap solution and will cut cleaning time by about 25 percent. Wash coils in the direction of flow as well as in the opposite direction of flow. *Do not use hot water.*

ANNUAL

Allow about 30 minutes for each unit.

1) Replace all fan belts. *Do not roll new belts over sheaves.* Loosen the adjusting bracket so the belt can be slipped into place.

2) Check fan belt sheaves. If sheaves are grooved, replace them. Worn sheaves will lead to early belt failure and could cause bearing failure and fan damage.

3) Lubricate all fan bearings and fan motor bearings as recommended by the manufacturer. *Do not overgrease. Remember, more bearings fail from over greasing than from not enough grease.*

4) Check all damper linkages and tighten as necessary.

5) Check all panel doors for loose gaskets. Replace and repair them as necessary.

6) Caulk any seams or screw heads with silicone sealant to assure a water tight seal.

7) Check insulation on the interior panels to make sure it is tight. Reglue or replace as necessary.

8) At the startup of the heating and cooling seasons, it is recommended that the manufacturer's service representative be called in to tune the heating and cooling units for maximum efficiency. This requires special tools, testing equipment, and knowledge. Contact the manufacturer for advice. If the school maintenance team has the necessary expertise, the manufacturer's operation and maintenance manuals will list the proper settings for all operating and safety controls.

Rooftop air conditioning also should be included in the annual inspection of the heating and ventilating system. See the Annual Inspection Checklist in the Management Tools Appendix.

SAFETY

Servicing rooftop units may be difficult, because they are located in an area where the serviceman is exposed to the worst of the elements. Service is usually required when the conditions are adverse. Wintertime requires bulky clothing and restricts movement, and roofs are often covered with ice. Care must be taken to avoid getting clothing caught in fans and to avoid slipping and falling into an electric panel. To minimize danger:

1) Make sure the ladder or roof access is safe and free from ice.

2) Place a catwalk around the unit where service

personnel are working to keep them out of the ice and water.

3) Always use plastic or rubber covered handles on tools to avoid electrical shocks.

4) Never work on fans with the power on.

5) Never pry belts on over sheaves. It could injure a finger.

6) Never reset a safety control more than once without determining the cause. Repeated resetting can damage the equipment, and can result in personal injury as well.

7) Always latch panels open when working inside a panel. A sudden burst of wind can cause a panel to slam shut knocking the serviceman into the electrical controls.

ECOLOGY

There is a certain amount of unavoidable noise inherent in the operation of rooftop equipment; however, unnecessary noise can be avoided if fan bearings are properly maintained and fan belts properly adjusted. Unnecessary noise of unit cycling can be avoided if controls are properly set and maintained. To some, rooftop units are unsightly. They stick out all over the roof of a beautiful building. It helps if the units are kept painted to blend with the background and if bent or loose panels are immediately repaired. Proper burner adjustment avoids heat discoloration and rusting of flue stacks.

ENERGY

Pre-packaged rooftop units are probably more efficient than systems assembled in the field. The package concept gives factory engineers more control over the total system, including an opportunity to avoid some of the inefficiency which can creep into field assembled systems. For example, packaging allows closer sizing of fans, compressors, and motors. To maintain peak efficiency, however, good maintenance is required. The rooftop design concept allows the school maintenance team to perform most of the maintenance, but the complexity of troubleshooting may be beyond the capability of local service people. If so, consult the manufacturer.

Temperature Controls

The temperature control system installed in a school building may be from one of four manufacturers and may be one of three types: electric, solid state, or pneumatic. The control system's sole purpose is to automatically regulate the heating, ventilating, and air conditioning systems to provide human comfort as economically as possible.

The typical school building is different from most buildings in that it is filled with great numbers of energetic young people moving about rapidly, taxing the ability of the temperature control system to follow the quick changes that are required.

Like all mechanical equipment, temperature control equipment requires regular maintenance and inspection to perform properly. Many preventive maintenance programs are available from the temperature control manufacturers and should be used when required.

In order to prolong the life of control equipment and keep maintenance costs to a minimum, it is essential to service the major components of the temperature control system at regular intervals. Schedules for periodic maintenance are presented in the tables on the next page.

MAJOR COMPONENTS

Room thermostats control valves or damper actuators to allow more heating or cooling as required. They should be kept locked with non-tampering devices to prevent unnecessary adjustments and should be recalibrated at least once a year.

Valve assemblies regulate the amount of heating or cooling allowed in the system, and play a large part in total equipment performance. Valve packing and tight close-off should be checked regularly. See "Valves" earlier in this chapter.

Automatic damper actuator assemblies should be checked periodically for loose mounting, mechanical connections to the damper, and diaphragm condition.

Bulb type thermostats are normally installed on or near the heating-air conditioning equipment and control entering and leaving air temperatures

Maintenance Schedule for Pneumatic Temperature Controls

	Weekly	Quarterly	Semi-Annually
Air Compressors and Accessories			
Drain and inspect tank	x		
Drain and refill crankcase oil		x	
Oil electric motor			x
Clean and/or replace air intake filter		x	
Check belt tension. Replace worn belt	x		
Inspect and/or replace pressure switch contacts		x	
Check pressure relief valve setting	x		
Check pressure reducing valve setting	x		
Check air lines for moisture, oil and dirt	x		
Check sediment and water trap	x		
Room and Remote Bulb Thermostats and Humidistats			
Check calibration			x
Check throttling range			x
Check air connections			x
Adjust system sequence			x
Dampers and Damper Motors			
Check travel and close off		x	
Lubricate blade and linkage bearings		x	
Check motor connections and spring		x	
Adjust system sequence			x
Valves			
Check operation for tight close off		x	
Lubricate valve stem		x	
Inspect and/or replace packing		x	
Replace disc where necessary			x
Relays, Pilot Valves, Switches			
Check operation		x	
Adjust system sequence			x

Maintenance Schedule for Electric or Solid State Temperature Controls

	Weekly	Quarterly	Semi-Annually
Room and Remote Bulb Thermostats and Humidistats			
Check calibration			x
Check throttling range			x
Check electric connections			x
Adjust system sequence			x
Dampers and Damper Motors			
Check travel and close off		x	
Lubricate blade and linkage bearings		x	
Check electrical connections		x	
Adjust system sequence			x
Valves			
Check operation for tight close off		x	
Lubricate valve stem		x	
Inspect and/or replace packing		x	
Replace disc where necessary			x
Relays, Pilot Valves, Switches			
Check operation		x	
Adjust system sequence			x
Power Supply—Line or Low Voltage			
Current consumption and voltage should be checked with amprobe and compared with original design for potential problems. Normal system voltages are 24 or 110 volts.			

at the unit. They, too, should be kept clean and calibrated and the temperature checked regularly.

Low temperature (freeze) thermostats protect the water and steam coils from freezing during severe weather. This instrument has a 20-foot element and is installed diagonally across the face of the coil surface. It should turn the supply fan off and close outside air dampers when actuated. It is very important to check the operation of the low temperature thermostat periodically. Use cold water or ice cubes to activate the device.

Dampers—There are many automatic dampers installed in heating/air conditioning systems, and one of the most important is the outside air damper. This must be checked periodically for tight close-off to prevent cold air infiltration and energy waste. While all dampers require cleaning, painting, and lubrication, they should be visually inspected while opening and closing to be sure of proper operation.

Switching relays and accessories—Most

systems include a control panel or board that houses the many switching devices required for systems operation. These can be checked only by running the system through its sequence of operation and should be performed by a trained control mechanic.

Air compressor assembly (pneumatic systems only) normally consists of the compressor assembly, refrigerated air dryer, filters, pressure reducing and safety valve. Normal storage tank pressure is 80 pounds per square inch (PSI) and system pressure is 15 to 20 pounds PSI. This equipment must be checked periodically and kept in top working condition. Should any oil or water reach control lines, serious problems with controls will occur.

SYSTEM ECONOMICS

The following suggestions may be of some value in conserving energy for your systems.

1) Use the lowest room thermostat setting that is acceptable.

2) Reduce day-night schedules to keep equipment off as much as possible.

3) Operate mixed air, hot deck, cold deck at most efficient temperatures to prevent excessive cycling, i.e., heating to cooling, cooling to heating.

4) Have outside air intakes checked for amounts that are required and eliminate unnecessary use of outside air during severe weather.

5) Check outside air and vent air openings for tight close-off of the automatic dampers during off periods to prevent infiltration.

6) Schedule regular maintenance for the mechanical system, including the control system.

7) Install thermometers in the inlet and outlet of the supply fan for a quick check on system operation. This will tell you quickly of any failure in the outside air damper or the heating and cooling valve.

21/Sanitary Systems and Fixtures

FAUCETS

Most of today's faucets are of the replaceable cartridge type, although faucets with hard rubber or composition gaskets are still being used.

When the cartridge type develops a problem, the entire cartridge should be replaced. Most cartridges are made entirely of plastic. To replace, first close the branch supply valve. Then remove the index or decorative covers; remove the screw that holds the handle to the replaceable cartridge; unscrew the union nut that secures the cartridge to the faucet body, and remove the cartridge. To install the replacement, simply reverse this procedure.

Replaceable cartridge type valves have no springs, no wearing action on rubber gaskets, and no 0-rings or packing on the stem to wear or leak. A simple cam activated movement of the diaphragm controls the flow of water. A metering-type replaceable cartridge is basically the same except that it shuts itself off after a certain amount of water has flowed through. The replacement procedure is the same.

A faucet with a hard rubber or composition gasket can develop a leak, as evidenced by water dripping from the faucet. Gaskets wear out and must be replaced. To replace the gasket, the branch supply valve should first be closed. Then remove the handle assembly by unscrewing the union nut and turning the handle counterclockwise until it is freed from its channel. The gasket is held in place by a small screw. Remove the screw and old gasket, place a new gasket on the shaft, and then re-insert the screw and tighten it. The bushing and valve seat should be checked for scars or erosion that could cause a leak.

WATER CLOSETS

Water closets operate by releasing water from a flush tank or from the supply line by means of a flush meter valve. They should be made of a dense impervious material with smooth surfaces to prevent the build-up of mineral deposits. The most common materials are vitreous china and stainless steel.

Tank Type: The tank type water closet has a reservoir mounted on or above the back of the fixture. Water is released from this reservoir to flush the water closet by moving a handle, which lifts a rubber ball from its seat on the discharge pipe. As the water level in the reservoir recedes, a float falls and opens a supply valve. The tank has an overflow pipe to prevent flooding in case the supply valve sticks open. The constant discharge of water to this overflow may require bending the float rod to lower the water level. If the float itself is water logged, however, it should be replaced. If a leaking plunger valve is causing the discharge of water, then the thumb screw should be removed from the valve, the rod level taken out, and the plunger removed. A washer at the end of the plunger should be replaced and the valve seat checked and reground if it is cut or scored. Then the assembly should be replaced.

Floats sometimes become water logged because of punctures or leaks around their threads. This prevents their rising as the water level in the tank rises and causes the intake valve to remain open, permitting a continuous flow of water to the tank.

Flush balls are usually made of rubber, are spherical, and have a lift rod screwed into one end. The purpose of the flush ball is to seal the dis-

charge pipe after flushing so that the tank will be refilled.

Both the flush ball and the float can be replaced with new ones by simply unscrewing them from their respective rods and screwing on new parts.

Flush Valves: Flush valves depend upon water volume and pressure for operation. These are metering valves, which complete their cycle and shut off automatically. Flush valves are generally classified into two groups: diaphragm type and piston type. The operation of each is fundamentally the same. Each has an upper chamber and a lower chamber connected by a bypass, which is a small hole no larger than a pinhole. In the diaphragm type, the separation between the two chambers is by a flexible diaphragm; in the piston type, a piston with a molded cup separates the two chambers.

With either type, when the handle of the valve is moved, pressure is released from one chamber, thereby opening the water line and allowing the water to flow into the fixture with sufficient force to flush and cleanse it. While water is flowing from the supply line, a small amount passes through the tiny hole to re-establish pressure in the other chamber, causing the valve to close and shut off the flow of water.

Generally, the only maintenance required to the flush valve is to keep it cleaned, especially the tiny opening between the two chambers. Gaskets, washers, and other rubber or plastic parts wear out and have to be replaced occasionally. Also, in the diaphragm type, diaphragms have to be replaced every three or four years.

URINALS

Urinals are manufactured as floor mounted, wall mounted and free standing, in a number of sizes and shapes. Urinals are most commonly manufactured of vitreous china or stainless steel. As with water closets, flushing is accomplished by means of a flush valve or water tank. The wall mounted models are the most popular because of their advantages in cleaning and maintenance. Siphon-jet and blow-out urinals provide a flushing action and will remove foreign matter such as cigarette butts and gum wrappers. The wash-out and wash-down models are quieter in operation but they are intended to remove liquid waste only.

The flush tank-type urinal consists of a tank mounted on the wall above the urinal with a siphon, or upside down U-shaped tube, leading from the tank to the urinal. The siphon discharges water from the tank to flush the urinal as frequently as water fills the tank to a predetermined level. The water supply line to the tank has a throttling valve to control the frequency of flushing by controlling the time it takes to fill the tank.

Siphons sometimes develop leaks, causing loss of air. These must be stopped, because loss of air from the siphon tube will cause it to stop functioning.

SHOWERS

Showers consist mainly of a shower head and a shower valve. Shower heads require little maintenance other than occasional cleaning to remove mineral deposits.

Shower valves fall into four classifications: two-valve type, the mixing valve (which includes the pressure balance type), the thermostatic valve, and master control valve system.

The two-valve shower consists of two valves constructed similar to a faucet. The valves have composition gaskets and seats or replaceable cartridges. For replacement procedures, see the section on "Faucets."

The mixing valve consists of a single lever valve which controls the temperature of the shower water. A sudden reduction in either the hot or cold water supply pressure (usually cold water because of flushing water closets) causes an uncomfortable change in the water temperature. This problem is almost entirely eliminated in the pressure-balanced mixing valve.

The thermostatic valve controls the water temperature by a heat sensing element that in turn moves the hot and the cold mixing parts of the valves. These valves are normally provided with a strainer on the hot and cold inlet supplies to remove any sand, grit, or other substance which may be present in the water mains. The strainer should be cleaned at the first indication of slow response to water temperature variation or when pressure variation is noticeable.

The master control system consists of a thermostatic controller that maintains pre-set tempered water to all hand washing or shower areas. With this system, tempered water is provided to the fixtures at pre-set temperatures; cold water is not normally provided to the fixtures. These valves, similar in operation and construction to the thermostatic mixing valve, should have the strainers cleaned monthly.

COLUMN SHOWERS

Column shower control valves can be the same

as for other showers. Any leakage around the shower head may indicate a hole in the control valve. Because there are usually from three to six shower stations at each column, this will require checking each valve. If the shower head delivers an uneven spray, remove and disassemble it and remove foreign matter. Shower drain cleaning can be accomplished with a plumber's snake inserted through the hand hole of the column.

If the column shower is provided with a push-button metering valve, it will be similar to the faucet metering valve in operation and maintenance.

The time cycle of the metering shower valve may be changed by removing the plug button on the push knob, loosening the allen set screw, and adjusting the travel distance with a thin-blade screwdriver in the center hole of the push knob. Turn the push knob while holding the screwdriver firmly. Turn the knob clockwise to shorten the shower cycle or counterclockwise to lengthen the cycle. Adjustments may vary with different manufacturers.

Pressure Balancing Valves

The term "pressure balancing" indicates the valve is provided with either a piston or a diaphragm that equalizes pressures between the hot and cold water supplies. (The cold water usually varies the most because of the operation of flush valves on urinals and water closets.) When operating properly, the hot water will not flow if the cold water supply to the valve is shut off, thereby reducing the possibility of scalding bathers. To service the pressure balancing valve, first open it to about the warm position. Then loosen the handle screw and remove the handle. Remove the escutcheon, unscrew the dial locknut and remove the dome cover. Then unscrew the valve cap with the complete assembly. Leave the packing nut in place while unscrewing the cap to avoid distorting the end of the cap. When the cap is unscrewed, the entire working unit may be removed.

The perforated cylinder is an integral part of the spindle and it does not unscrew. The cylinder is hollow and contains a piston; the piston is free moving and provides the pressure balancing feature of the valve.

The piston should move freely inside the cylinder at all times, and should click back and forth when the assembly is shaken. After long service in rugged waters, mineral or other deposits may block the piston's action.

Normally, tapping the handle end of the spindle against a solid object will free the piston. If it is so solidly plugged that this is not effective, replace the entire spindle assembly.

Ordinary service requires only the replacement of hot and cold water washers. It is essential that both hot and cold washers be replaced at the same time, even if only one appears to require attention. *Use only pressure balanced valve washers.*

When reassembling the valve after any repairs, be sure that the cylinder is drawn close to the cap before screwing the cap back into position.

Thermostatic Valves

Most thermostatic valve repair involves changing the slip ring and the power element. Usually these operations will eliminate temperature fluctuations. Disassemble valve top, spring, main valve slide and power element. Handle the power element cautiously so as not to damage.

Take a pocket knife or some pointed object and remove the old slip ring. Insert a new slip ring into the recess or channel. Install the power element. Apply grease to the main valve slide and gently ease it into position. Rotate the slides as grease is applied to the slip ring. Do not force as this could push the ring out of its socket. To test, rotate the slide and if it is properly in position, a slight drag will be felt. Reassemble the remainder of the valve.

If no hot water is available, check the source of supply for corrosion which may have closed the supply line.

To prevent foreign matter from getting into the thermostatic valve and causing problems, it is often protected by a strainer check-stop. Shut off the screwdriver stop, remove and clean the strainer, and inspect the check-stop for smooth operation.

DRINKING FOUNTAINS

Drinking fountains (non-refrigerated) are manufactured from many different materials, the most common being vitreous china, enameled cast iron, precast stone and stainless steel. They may be surface mounted, semi-recessed, or fully recessed.

In selecting a recessed or semi-recessed model, check to be sure that the wall is deep enough to accommodate the unit and its related piping.

All three types are provided with a stop fitting, usually screwdriver operated, which is used to shut off the flow of water to the fountain and to adjust the height of the bubbler stream. The adjustment is made from below on all but the fully recessed type, which has an access cover place on the front.

The bubbler is controlled from a self-closing valve, which is either a spring-return handle, push button or foot pedal. The latter operates by compressing a spring and a washer and seat. The most common type of bubbler operator is a compressed spring that keeps pressure against two cams separated by a ball race or ball bearing. As the handle is turned, the cams operate against each other with the aid of the bearing, opening and closing the valve against the seat.

The bubbler height should be adjusted so the stream arches up above the bubbler saliva guard so that the mouth of the user need not touch the guard.

ELECTRIC WATER COOLERS

Electric water coolers are manufactured from the same materials as drinking fountains but have a wider selection of colors and finishes available. They may be surface mounted, semi-recessed or fully recessed.

Electric water coolers consist of a self-contained air flow condensing unit. The refrigeration unit cools the water to approximately 50 degrees F., which is considered the desirable drinking water temperature.

Adjustment of the bubbler stream usually requires removal of the valve handle (which is secured to the valve by an allen-type set screw) and unscrewing the bubble stream nozzle. The bubbler saliva guard can then be removed. To adjust the stream height, reconnect the stream nozzle, without the saliva guard and valve housing. An adjustable pressure regulator is a part of the bubbler valve and has a screwdriver adjustment for regulating the pressure (stream height).

Keep in mind the many times the bubbler stream can be adjusted by adjusting the supply stop. However, if water pressure exceeds 50 PSI, adjust pressure to the regulating valve, as excessive pressure will wear the stop.

A remote water cooler is a term used for condensing units that are not housed within the drinking fountain enclosure. Units of this type pipe the chilled water from the refrigeration unit to a drinking fountain as previously described. It is important that the piping between the remote cooler and the drinking fountain be well insulated to maintain the desired temperature, to prevent excessive operation of the remote unit, and to prevent the water in the atmosphere from condensing on the cold pipe and dripping.

Other than making sure that dust and dirt do not accumulate within the cabinet, which reduces cooling efficiency, little maintenance is required.

The foot pedal operation is normally by a series of rods, springs and levers which connect to the handle valve. Maintenance requirements are limited to adjustments and replacement of a spring or rod.

WASH FOUNTAINS

Wash fountains come in a variety of materials, including stainless steel and molded stone, and sizes range from semi-circular to circular and from free-standing to wall hung and are foot or hand operated.

Valves controlling the temperature of water for wash fountains are normally the manual mixing valve or the thermostatic type mixing valve similar to those for showers (see pages 164 and 165).

Periodic cleaning of spray heads is recommended. Frequency depends upon the mineral content of the water. To clean, remove the wing or hexnuts, drop the lower spray head ring and clean out chips and other foreign material with a wire brush. Lime build-up can also be removed in this manner.

22/Sewage Treatment Plants

The sewage treatment plant must be given regular and proper attention. It is a substitute for municipal sanitary sewers and sewage treatment plants.

Proper maintenance and operation is necessary. Neglect or improper maintenance may necessitate complete reconstruction of the plant in a relatively short time. Objectionable odors and unsanitary conditions will result from improper operation.

Private sewage treatment plants employ a variety of unit processes that can be arranged in a variety of combinations and configurations. In general, private sewage treatment plants fall into two categories: those using a septic tank or those using some form of aerobic biological treatment. The diagrams in Figure 22-1 show several treatment systems. The treatment systems shown all include solids removal and biological treatment, either aerobic or anerobic, to reduce the dissolved organic matter content of the sewage.

In addition to proper operation and maintenance, the sewage treatment plant must be designed and built properly if it is expected to perform properly. All sewage treatment plants must be installed and operated in strict accordance with the requirements of the State's Environmental Protection Agency.

SEPTIC TANKS

A septic tank (Figure 22-2) removes settleable and floatable solids from sewage. The solids that settle to the bottom form sludge. The solids that float to the liquid surface form a scum layer. All solids retained in the septic tank are subjected to anaerobic biological decomposition. This reduces the quantity of organic solids by biological conversion to water, gas and energy (cell reproduction). The bacteria necessary for most biological sewage treatment processes are normally found in domestic sewage.

Maintenance

Inspect septic tanks at least twice a year. Check baffles or pipe fittings. They should be in place at inlet and outlet. These baffles or pipe fittings prevent scum and solids from entering the outlet sewer and prevent currents across the tank.

Cleaning

When total depth of scum and sludge exceeds one-third the total depth of the tank, it must be cleaned. Frequency of cleaning depends upon the size of the tank and the daily flow. Garbage disposals increase cleaning frequency. No chemical or digesting yeast will completely clean a septic tank. Sludge can be removed only by special cleaning equipment and should be removed and disposed of by a licensed special waste hauler. Call the health department for help in obtaining this service.

Following is a section from the "Manual of Septic Tank Practice" as published by the U.S. Department of Health:

> "Chemicals—The functional operation of septic tanks is not improved by the addition of disinfectants or other chemicals. In general, the addition of chemicals to a septic tank is not recommended. Small amounts of chlorine bleaches, added ahead of the tank, may be used for odor control and will have no adverse effects. Small quantities of lye or caustics normally used in the home, added to plumbing fixtures is not objectionable as far as operation of the tank is concerned. If the septic tanks are as large as herein recommended, dilution of the lye or caustics in the tank will be enough to overcome any harmful

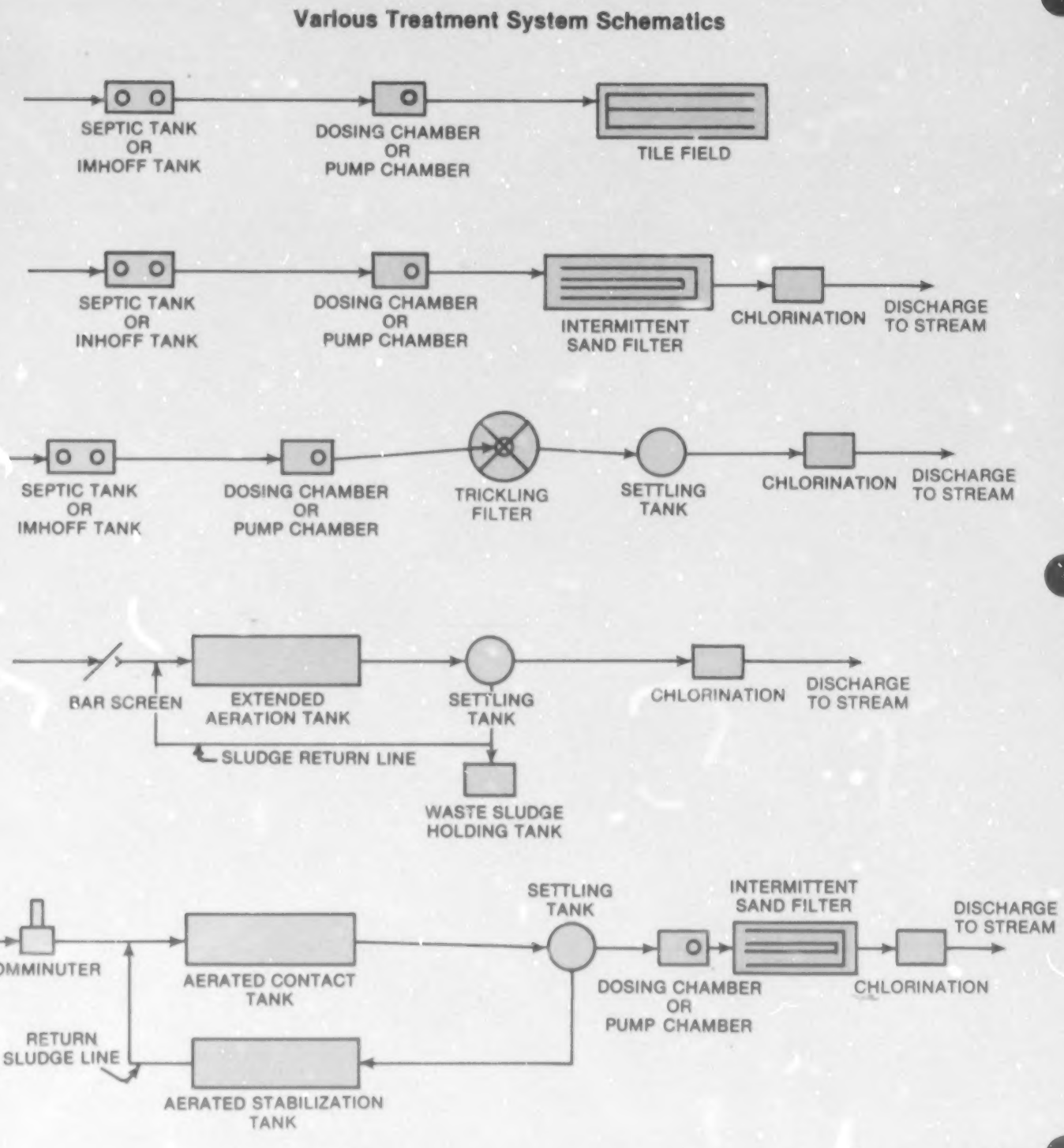


Figure 22-1—Diagrams show five different sewage treatment systems.

effects that might otherwise occur.

"Soaps, detergents, bleaches, drain cleaners, or other material, as normally used in the household, will have no appreciable adverse effect on the system. However, as both the soil and essential organisms might be susceptible to large doses of chemicals and disinfectants, moderation should be the rule. Advice of responsible officials should be sought before chemicals arising from a hobby or home industry are discharged into the systems."

IMHOFF TANKS

Whereas the septic tank has only one level or story, the Imhoff Tank (Figure 22-3) consists of two stories to provide both solids removal and digestion. This arrangement allows minimum contact between the sewage and the settled, digesting sludge and the detention period is reduced. Imhoff Tanks can be either circular or rectangular and are divided into three chambers: the upper section called the flow-through chamber or settling compartment; the lower section known as the sludge digestion chamber; and the gas vent and scum chamber at the edges of the tank.

Sewage flows through the upper compartment and solids settle to the bottom. The bottom of the flow-through chamber is sloped so that accumulated solids can slide down to the opening at the bottom. One of the bottom slopes extends at least six inches beyond the opening. This forms a trap to prevent gas or digesting sludge particles in the lower section from entering the upper flow-through section. The gas and any rising sludge are diverted to the gas vent and scum chamber. This eliminates the main disadvantage of septic tanks.

Piping is provided for withdrawal of sludge from

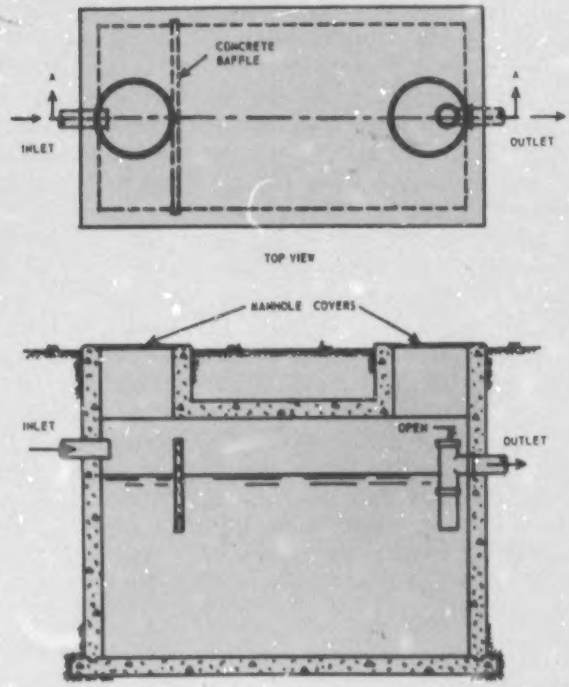


Figure 22-2—Septic tank.

the lower chamber. After sludge withdrawal, the pipes should be flushed and filled with water or sewage to prevent sludge from clogging the pipe. All sludge should be disposed of properly.

The Imhoff Tank has no mechanical parts and is relatively easy and economical to operate.

Some suggested maintenance steps for Imhoff Tanks are as follows:

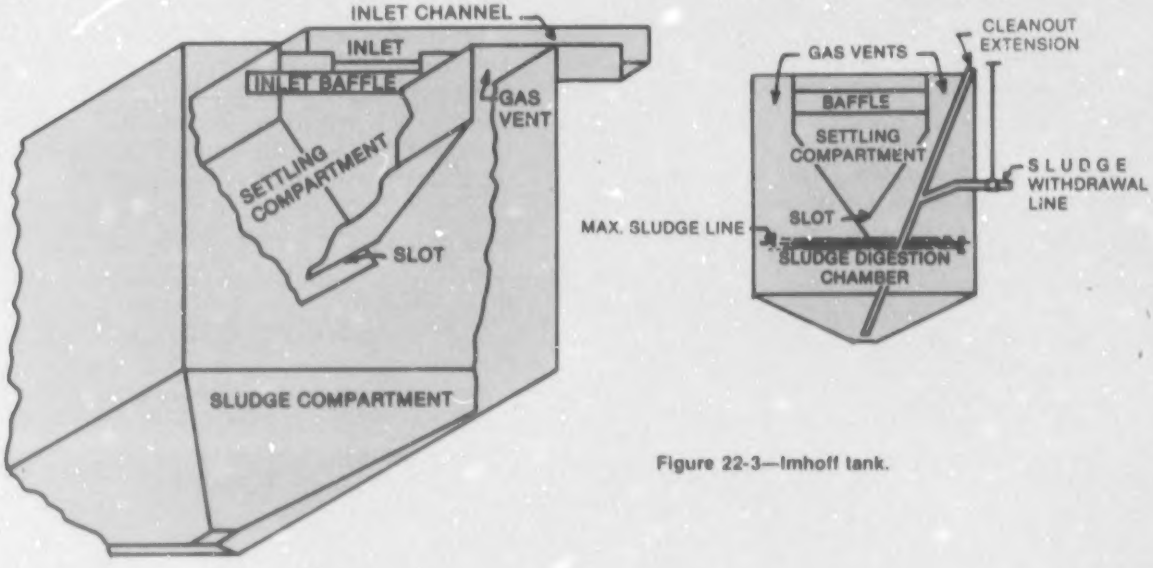


Figure 22-3—Imhoff tank.

1) Remove scum and floating materials daily from the upper flow-through chamber.

2) Scrape the sides and sloping bottom of the upper compartment weekly to remove solids adhering to the lower digestion chamber.

3) Clean the slot at the bottom of the upper chamber weekly. This can be done with a drag chain.

4) Scum from the scum chamber should be removed and properly disposed of as needed, usually when the layer approaches two feet thick.

5) Sludge removal from the lower digestion chamber should be done frequently in small amounts rather than in large amounts at long intervals. Sludge withdrawal should be done slowly to prevent the formation of a channel through the thick sludge which would allow partially digested sludge and liquid to be withdrawn. Just before winter, about 75 to 80 percent of the sludge should be withdrawn to provide volume for winter storage when digestion is slowed by lower temperatures.

DOSING CHAMBER

Sewage flows from the septic tank and accumulates in the dosing chamber; then, at a preset water level, a siphon automatically discharges sewage to a tile field or an intermittent sand filter. There may be one or two siphons in the dosing chamber. If there are two siphons, they may alternate automatically every time the dosing chamber fills. (See Figure 22-4.)

Inspection

Inspect siphon operation at least twice each week. The dosing chamber must fill to a level about three inches below the overflow pipe and then empty rapidly. Otherwise, siphons are not operating properly.

Siphons must operate automatically and alternately. They should discharge from one to four times daily depending on the flow.

Operation for Starting Siphon

1) Remove the bells.

2) Make certain the main traps are clean.

3) Fill the traps of both siphons with water.

4) Make certain bells are replaced tightly on traps to prevent the escape of air.

Check Traps

1) The idle trap may refill when the other siphon operates. There are several possible causes:

- A leak in the floor or discharge line.

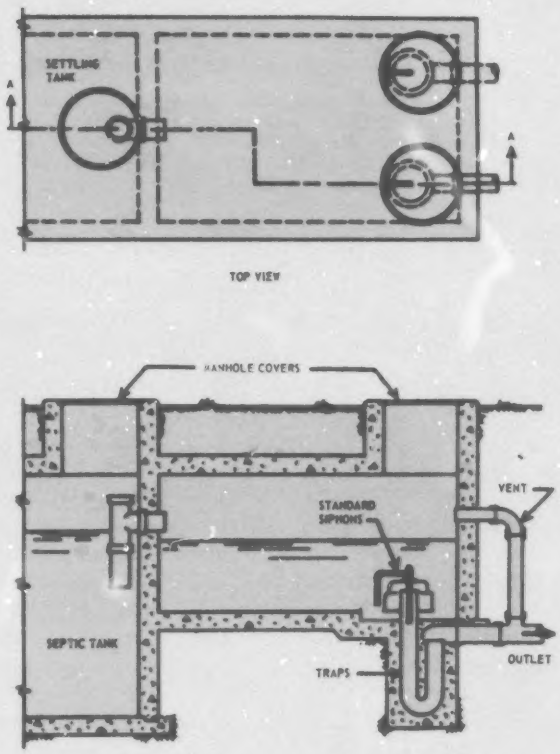


Figure 22-4—Dosing chamber with alternating siphons.

- Backing up of sewage into the discharge line from the manhole or filter beds.
- Clogged discharge line.

2) Make certain the outlet from each siphon is free.

PUMP CHAMBER

Sometimes alternating pumps are substituted for siphons in a wet well. (See Figure 22-5.) Dual pumps are operated alternately by a float controlled automatic switch. The pump chamber requires the following service:

Pumps and Motors

1) Follow manufacturer's lubrication instructions.

2) Allow good ventilation for motors to prevent condensation.

3) Check daily for overheating of the motors.

Float Controls

1) Inspect the float control daily.

2) Replace if the float or float rod is badly corroded.

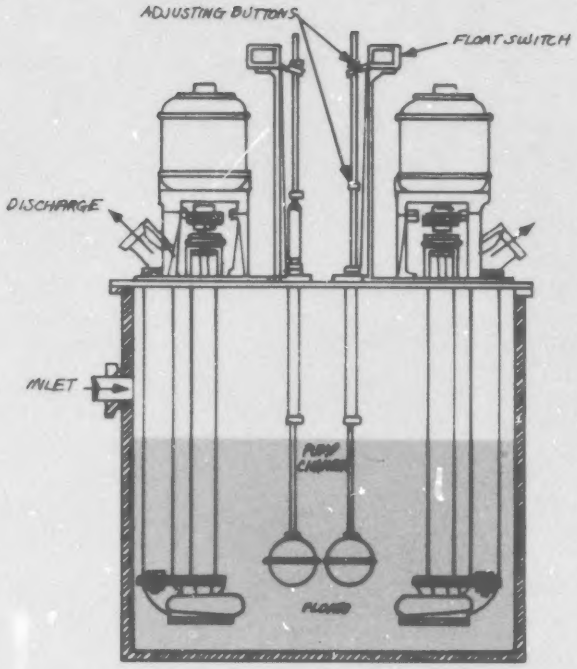


Figure 22-5—Pump chamber with alternating pumps.

3) If switch is out of adjustment, a skilled workman may be needed to make repairs. Consult the manufacturer.

Cleaning

1) Clean the screen if clogged with grease and suspended matter.
2) Clean the chamber as required.

INTERMITTENT SAND FILTERS

Intermittent sand filters (Figure 22-6) consist of sand and gravel layered in a bed through which the sewage seeps. The sand filters are intermittent because they are normally dosed and allowed to drain before being dosed again. If parallel filters are used, alternate dosing is generally done by automatic alternating dosing siphons or pumps.

The filtered sewage (filtrate) is collected in open jointed drain piping beneath the filter bed. The sand filter removes solid matter and also acts as a fixed media biological treatment unit when operated properly.

Check Daily

Surface sand filters should be checked every day for clogging, which is indicated when sewage remains on the surface of the sand longer than 30 minutes. Clogging is caused by solids and grease

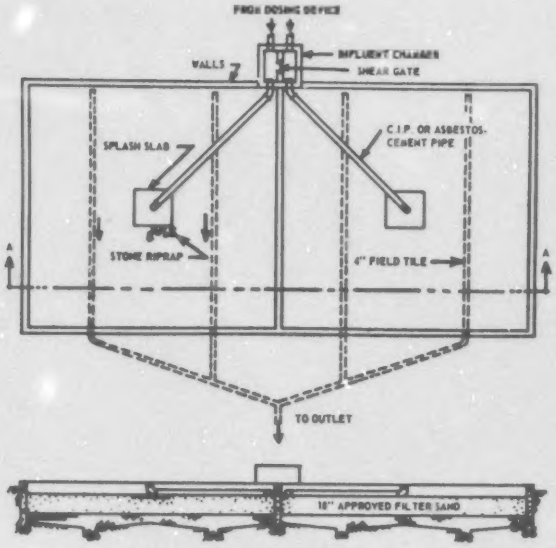


Figure 22-6—Intermittent sand filter dosed by flooding.

from the previous treatment unit. Observe the sewage in the influent chamber. Liquid should be fairly clear and free of visible solid matter.

Debris

Clogging may be caused by weeds, leaves, and other surface debris. If necessary, build a fence around filters to prevent trespassing and dumping of rubbish. Pave the slopes of surrounding banks or build a tight wall to keep soil and other surface wash off the beds. Pull out weeds and roots.

Sewage Distribution

Large volumes of sewage must be dosed into the filter beds. Don't allow sewage to trickle into the bed continuously. Keep the sand raked level and adjust the inlet for even distribution. Distribution troughs, tile, or pipe are needed for even distribution.

Overloading

Clogging may be caused by applying too much sewage to the filters. Loading rates and estimated flows may be verified by contacting the State Environmental Protection Agency.

The wrong kind of sand also will clog filters. Only use sand approved by the state department of health.

Remedies for Ponding

If sewage is not absorbed, divert the flow to the second filter. Allow the sand to dry thoroughly.

Scrape the thin crust off the surface after the filter bed has dried. Do not use a rake or rotary tiller before all foreign material is removed. If sewage still ponds, take the filter bed out of service again and allow the sand to dry completely. Remove an inch or two of incrusted sand with a flat shovel. This should be done about once a year or when necessary. When sand has been reduced by about four inches, add clean, approved filter sand to original depth. The state department of health will furnish specifications for the sand and test it for suitability.

TILE FIELDS

Tile fields can be used as an ultimate disposal method where climate and soil conditions permit (Figure 22-7). Tile systems receive settled sewage from the septic tank either on a continuous basis or dosed in a similar manner as sand filters. The sewage flows into the open-jointed tiles and drains into the sand and gravel bedding. The tile field has two feet of earth over the media to prevent surface saturation. Effluent sewage seeps into the ground, being treated by the microorganisms living in the

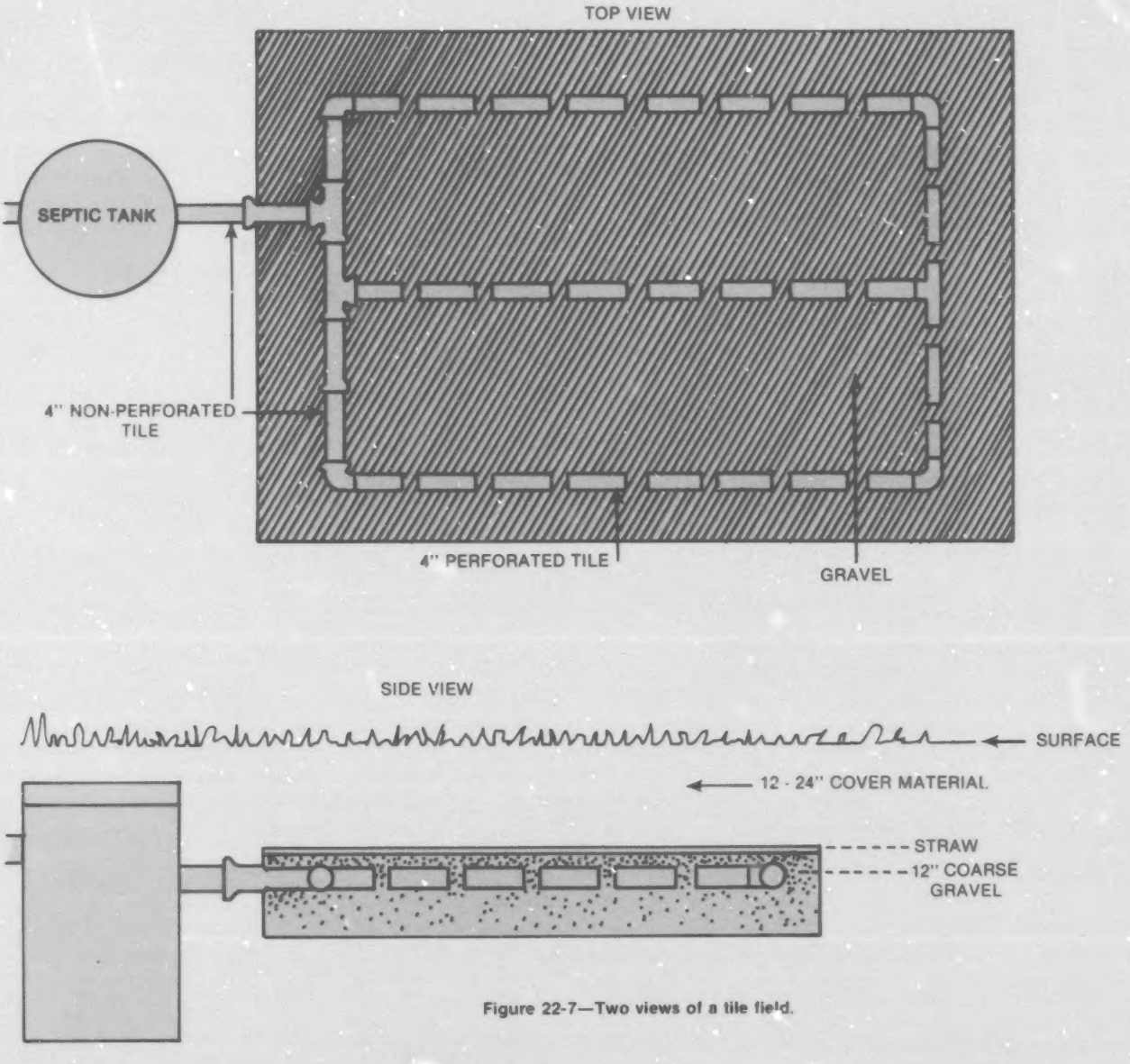


Figure 22-7—Two views of a tile field.

soil. Some water is also lost to evaporation and plant transpiration, depending on seasonal changes.

Overloading

The tile field may clog if improperly treated sewage is allowed to enter. Solid material can plug the soil pores, greatly reducing the soil absorption rate. The septic tank should be checked for excess solids accumulation if this is suspected. Soil saturation by higher groundwater levels or heavy rainfall may also reduce capacity of the soil. Surface runoff water should be diverted away from the tile field area.

Maintenance

Routine maintenance for tile fields includes proper operation of the septic tank to insure proper solids removal. The tile field area should be kept free of debris and planted in grass. The grass should be kept short to facilitate maximum evaporation. Vehicles should be kept off of the tile field to prevent compaction of the soil and damage to the piping.

TRICKLING FILTERS

A septic tank is necessary ahead of the trickling filter in order to prevent clogging of filter nozzles. A trickling filter is a bed of stone or slag over which sewage is distributed by rotating arms or fixed spray nozzles (Figure 22-8). As the sewage trickles through the filter bed, the organic matter in the sewage is captured and digested by the aerobic microorganisms that grow as a slime on the filter rock. The underdrain system collects the sewage as it comes out the bottom of the trickling filter and provides necessary air circulation up through the filter bed.

Ordinarily a trickling filter will slough; that is, the biological solids will break away from the rocks, peaking in the spring and fall of each year. These solids must be removed from the final settling tank daily, either by pumping them to the first settling tank or by pumping them to a sludge holding tank for proper disposal.

Rotary Distributors

Rotary distributors are used on some surface sand or trickling filters. (Figure 22-9.) The sewage

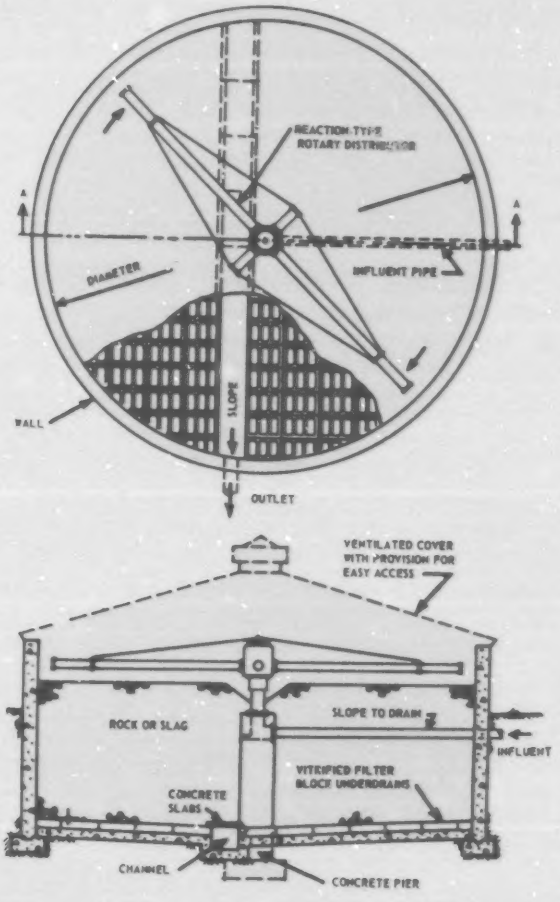


Figure 22-8—Trickling filter.

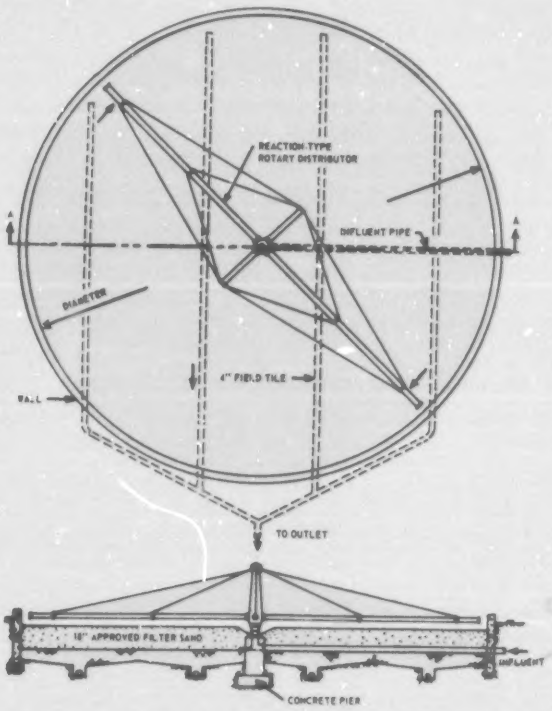


Figure 22-9—Rotary distributor on sand filter.

is evenly distributed over the filter through holes or nozzles in the arms. The distribution arm rotates by means of hydraulic pressure created by the jets of sewage leaving the nozzles.

Trickling filters must be inspected regularly for ponding.

Causes of Ponding

1) Sewage on the filter must contain dissolved oxygen to encourage growth of aerobic bacteria. Overloading sometimes depletes oxygen, causing ponding and odors.
2) An accumulation of leaves on the filter.
3) Unsatisfactory stone or slag.
4) Excessive amounts of grease and solid matter from the septic tank.
5) Improper care of septic tank. Clean it regularly.

Remedies for Ponding

1) Rake or fork the surface.
2) Punch holes in the top layer.
3) Rest the filter several days.
4) Flush the surface with a high pressure stream of water.
5) Replace small size stones with approved stone or slag.
6) Dose filter with chlorine to kill excess bacterial growth.

Maintenance

1) Check the turntable for binding.
2) Follow manufacturer's recommendations for lubrication and cleaning the media.
3) Inspect and clean nozzles daily. If holes are clogged, distribution of sewage will be uneven and result in clogged filters. It may lead to the breeding of insects in the trickling filter.
4) Open the covers at the ends of the arms and flush the arms daily while the equipment is operating.
5) Keep the septic tank in good condition. Clean it regularly.

LEACHING WELL

A leaching well is a hole in the ground, walled with brick, concrete block, or stone (Figure 22-10). It allows liquid from the septic tank to seep into the subsoil in much the same way as a tile field.

Clogging of the leaching well may be caused by solids and grease from the septic tank. Proper septic tank care is extremely vital; clean it regularly. When the subsoil becomes so saturated with sewage that leaching will no longer take place, it is necessary to build a new one.

ACTIVATED SLUDGE

Aerobic biological treatment systems use the organic matter in sewage as a source of food for cell reproduction. The most common types of aerobic biological treatment systems include *trickling filters* and *activated sludge systems.*

Trickling filters are discussed above. This sec-

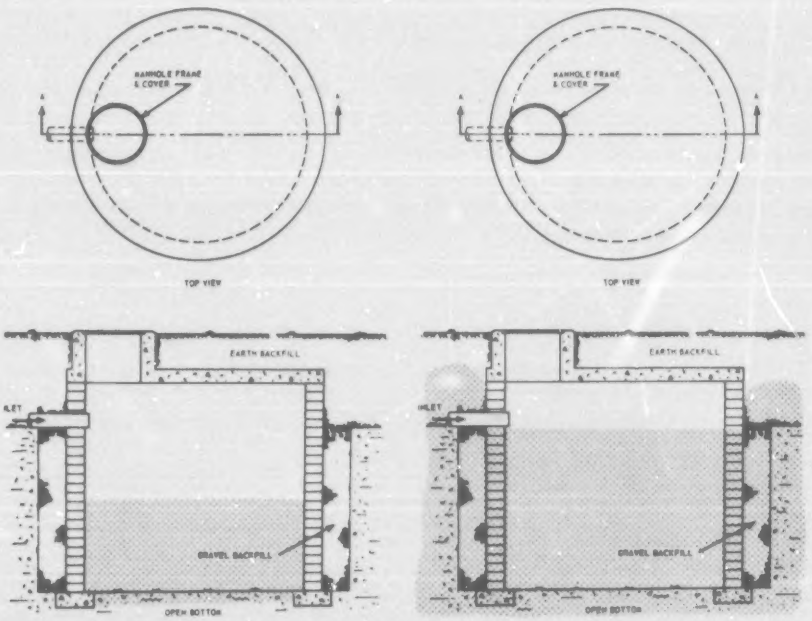


Figure 22-10—Leaching well (left) and saturated leaching well (right).

tion will focus on the more common types of activated sludge systems. The common components of an activated sludge system are:

- Preliminary treatment
- Aeration tank
- Settling
- Sludge holding
- Chlorination

1) Preliminary treatment removes large solid materials from the sewage. Two ways of doing this are with a bar screen or a comminutor.

A bar screen is simply a row of vertical steel or aluminum bars set into the flow stream. The openings between the bars are usually about one inch wide. The bar screen is usually set in the flow stream at an angle to make cleaning easier. When screenings accumulate, they should be removed from the bar screen with a rake or fork and properly disposed of by burial or burning. This should be done daily or more often if necessary.

Comminutors are used to grind solid material into small pieces so that pumps and piping won't be plugged or damaged. The comminutor consists of a stainless steel basket submerged in the flow stream. As the sewage flows through the comminutor basket, solid materials are captured. The basket has openings in the range of 1/4-inch. An electric motor on top of the comminutor drives the cutting blades which are mounted on a vertical shaft extending down from the motor. The cutting blades grind the captured solids against the steel basket and return them directly to the flow stream when they are small enough to pass through the basket. Comminution leaves no solids to dispose of.

Manufacturer's lubrication instructions should be followed, and submerged parts should be inspected once or twice a year to check for broken cutting blades and clogging.

2) The aeration tank is the heart of the activated sludge plant. This is where the decomposition of the organic matter in the sewage takes place. In the presence of oxygen, the microorganisms and the sewage are mixed. As the microorganisms eat the organic matter, grow and reproduce, the individual organisms clump together (flocculate) to form an active mass of microbes called "activated sludge." In practice, the sewage flows continuously into the aeration tank where air is injected to mix the activated sludge with the sewage and to supply the oxygen needed for the microbes to break down the organic matter. The mixture of activated sludge and sewage in the aeration tank is called "mixed liquor" or "mixed liquor suspended solids" (MLSS).

The mixed liquor flows from the aeration tank to a settling tank where the activated sludge is settled out. Most of the settled sludge is returned to the aeration tank to maintain a high population of organisms to permit rapid, efficient break down of the organics. Because more activated sludge is produced than can be used in the process, some of the return sludge is diverted or "wasted" to the sludge holding tank for disposal.

The two most common variations of the activated sludge process in use in private treatment plants are the "extended aeration" and "contact stabilization" processes. Extended aeration takes its name from the relatively long retention time in the aeration tank. The mixed liquor is aerated for about 24 hours before flowing to the settling tank. The long aeration period allows the activated sludge that forms to be partially digested within the aeration tank, thus reducing the volume of excess sludge for disposal. Sludge from the settling tank is returned to the aeration tank at a rate of 50 to 200 percent of the sewage flow rate.

Many small extended aeration plants are sold as prefabricated plants which are compartmented into aeration zone and settling zone.

Contact stabilization is a variation of the activated sludge process developed for applications where space is limited. The process consists of the "contact" (or aeration) tank where the activated sludge and sewage combine to form mixed liquor. Retention time in the contact tank ranges from 30 to 90 minutes. This is just long enough for the microbes to absorb the organic matter from the sewage but not long enough to allow them to be broken down. The activated sludge is then settled in the settling tank and put into the "stabilization" (reaeration) tank. Retention in the stabilization tank can range from 2 to 5 hours to permit the organisms to digest the absorbed organics. Because the settled volume of the activated sludge being aerated in the stabilization tank is much smaller than the total sewage flow, the total size of the plant is reduced.

Excess sludge generated by contact stabilization is generally wasted from the stabilization tank either to a separate sludge holding tank or directly to disposal. Sludge is returned from the stabilization tank to the contact tank at a rate of 50 to 150 percent of the incoming sewage flow.

Air for activated sludge systems is usually supplied by blowers. The air is introduced to the aeration tanks by a series of pipes, control valves and diffusers. The air must be properly distributed to maintain adequate mixing and oxygen supply throughout the tank. Package plants are generally

Some Sewage Treatment Terms

Employees who are responsible for maintaining sewage treatment plants encounter a great deal of technical terminology. Here is a glossary of some of the essential terms used in this chapter—terms that responsible employees will need to understand.

Absorption: Taking in or reception of one substance into the body of another by molecular or chemical action, and distributed throughout the absorber.

Activated Sludge: Sludge particles produced in raw or settled wastewater (primary effluent) by the growth of organisms (including zoogleal bacteria) in aeration tanks in the presence of dissolved oxygen. The term "activated" comes from the fact that the particles are teaming with bacteria, fungi, and protozoa.

Aerobic: A condition in which "free" or dissolved oxygen is present in the aquatic environment.

Anaerobic: A condition in which "free" or dissolved oxygen is *not* present in the aquatic environment.

Anaerobic Bacteria: Bacteria that live and reproduce in an environment containing no "free" or dissolved oxygen. Anerobic bacteria obtain their oxygen supply by breaking down chemical compounds which contain oxygen, such as sulfates (SO^4).

Bacteria: Bacteria are living organisms, microscopic in size, which consist of a single cell. Most bacteria use organic matter for their food and produce waste products as the result of their life processes.

Biochemical Oxygen Demand or BOD: The BOD indicates the rate of oxygen utilized by wastewater under controlled conditions of temperature and time.

Coliform: The coliform group of organisms is a bacterial indicator of contamination. This group has as one of its primary habitats the intestinal tracts of human beings. Coliforms also may be found in the intestinal tracts of warm-blooded animals and in plants, soil, air and the aquatic environment.

Dissolved Oxygen: Atmospheric oxygen dissolved in water or wastewater, usually abbreviated DO.

Distributor: The rotating mechanism that distributes the wastewater evenly over the surface of a trickling filter or other process unit.

Effluent: Wastewater or other liquid—raw, partially, or completely treated—flowing *from* a basin, treatment processs, or treatment plant.

Inorganic Waste: Waste material such as sand, salt, iron, calcium, and other mineral materials which are not converted in large quantities of organism action. Inorganic wastes are chemical substances of mineral origin and may contain carbon and oxygen.

Organic Waste: Waste material which comes from animal or vegetable sources. Organic wastes generally can be consumed by bacteria and other small organisms and contain mainly carbon and hydrogen along with other elements.

Septic: A condition produced by the growth of anaerobic organisms. If severe, the wastewater turns black, giving off foul odors and creating a heavy oxygen demand.

Sludge: The settleable solids separated from liquids during processing or deposits on bottoms of streams or other bodies of water.

supplied with two blowers, each having sufficient capacity to provide the total amount of air required.

3) **All activated sludge systems** require solids removal after the aeration tank. A settling tank is usually provided to separate the activated sludge from the "clarified effluent" which is discharged for further treatment. As previously described, the activated sludge is drawn from the bottom of the settling tank or "clarifier" to be returned to the aeration tank or to be wasted. Sludge return to the aeration tank (or contact tank in the case of contact stabilization) is usually continuous, with the rate of flow being controlled by manual adjustment. Wasting sludge from the system is done manually by opening a valve on a gravity drain line or turning on a pump. In a package plant where the clarifier is integral with the aeration tank, air lift pumps are usually provided which operate on the blower air supply. An air feed valve on the pump controls the rate of pumping.

The metal plate over which the effluent flows is called a "weir." The purpose of a weir is to control the velocity of the effluent as it leaves the clarifier.

If the velocity is too high, sludge particles may not settle and be carried out with the effluent. Thus, the solids removal efficiency of the unit is lost. Weirs should be set dead level. Weirs commonly have flat or saw-tooth edges. In general, the longer the weir, the lower the velocity for any given flow rate.

A baffle is usually located in front of the effluent weir and extends below the water surface. This blocks floating materials and scum from flowing out with the clarified effluent.

4) An activiated sludge plant should have some type of sludge holding tank. In contact stabilization systems, the reaeration tank serves the dual purpose of stabilization and sludge holding tank. Sludge is both returned to the aeration tank, usually on a continuous basis, and wasted to disposal from the stabilization tank.

A separate holding tank, either aerated or non-aerated, is needed with extended aeration systems. Excessive sludge quantities are not as large with extended aeration as with other forms of activated sludge processes, but periodic wasting is still necessary for good performance.

Sludge holding tanks are constructed of reinforced concrete, concrete block, steel, or impervious earthen lagoons.

Under circumstances where a higher degree of solids removal is required, the settling tank may be followed by a dosing or pump chamber with intermittent sand filters. These units are similar to those described in the section on septic tank systems.

5) State and federal regulations limit the number of bacteria that can be in treated sewage effluent which is discharged to the surface. For most treatment systems, this requires some type of disinfection. In small private plants, some form of hypochlorite is usually used.

Sodium hypochlorite (liquid bleach) is fed into the wastewater at a controlled rate by either a control valve or a metering pump from a large plastic solution tank. Calcium hypochlorite (dry chlorine as used in swimming pools) comes in two forms—powder and tablets. The powdered form is usually mixed with water in a plastic solution tank and fed into the sewage, as is the sodium hypochlorite. The solution tank should hold a 7 to 30 day supply of chlorine solution. Automatic chlorinators being marketed use tablets of calcium hypochlorite stacked in a plastic contact chamber. The unit has a slot at the outlet side that controls the level of sewage in the unit and, thus, controls the amount of chlorine used proportionately with the flow rate.

All chlorination systems have a "contact tank" following the addition of the chlorine. The tank is usually shaped and baffled to promote complete mixing of the contents. This is necessary to provide contact between the chlorine and any bacteria present. The contact tank is sized to retain the sewage for 30 to 60 minutes to allow the chlorine time to react.

Disinfection is generally the final treatment process prior to discharge.

RECOMMENDED MAINTENANCE

1) Be sure tanks are kept completely free of mud, sand, gravel, rocks, boards, and other debris.

2) Check oil level in the blower before starting up.

3) Do not turn on the spray pump until the plant is completely filled and water running out of the discharge. (If a spray pump is provided.) The scum return pipe should be adjusted so that water will be about 3/8 to 1/2 inch deep in the notch. Adjust the air valve so that water falls about 2 inches down in the pipe.

Daily

1) Make a daily inspection of the plant.

2) Rake the bar screen and burn or bury the screened solids.

3) Look for a uniform discharge of air in aeration tanks. (A quiet area indicates a clogged nozzle. Close the air valve, lift the diffusion unit, and clean the nozzle.)

4) Hose down the plant to remove foam and untidiness.

5) Squeegee growth from tank walls.

6) Check and break up scum, if any, in the settling tank to insure proper return through the skimmer.

7) Keep the chlorine stock solution tank or tablet chlorinator filled when needed.

8) Observe final effluent for clarity.

9) All areas having foam build-up should be washed down with water spray.

Weekly

1) Alternate blowers.

2) Clean air filter.

3) Check blower belts; keep center vertical movement at 1/2 inch to 1 inch.

4) Check time setting on time clocks.

5) Scrape wall and hoppers of settling tank.

6) Clean trash and weeds from around plant and equipment.

Monthly

1) Open gear box, oil drip drain—add oil if no

drip.

2) Lubricate blower bearings.

3) Check air filter and clean when necessary.

Semi-annually

1) Change oil in gear box.

2) Lubricate blower motors.

Annually

1) Wire-brush and paint all rusted metal.

Lubrication

1) Blower—Before starting blower, be sure to check to see if oil has been put in the gear housing.

2) Blower bearings—Renew grease as needed with best grade, high temperature ball bearing grease (not ordinary cup grease) about once a month.

Common Problems

1) Motors will not run:

- General power outage.
- Fuses blown—replace; reset circuit breaker.
- Motors overloaded—push reset button; check overload heaters if reset does not start motor.

2) Excessive foaming or liquid appears soapy in aeration compartment:

- Over aeration—reduce running time.
- Lack of solids (usually found only during the first few weeks of operation).
- Excessive use of detergents—eliminate them before they enter the plant.
- Spray with water hose to break up foam.

3) Liquid is black, caused by large amount of septic sewage or blower is not running long enough:

- Aerate until chocolate brown color returns.
- Find source of septic sewage and eliminate.
- Set time clock for adequate aeration time.
- Check V-belt drive.

It is important to check the appearance of the aeration tank contents. A satisfactorily operating plant will have a heavy concentration of chocolate brown sludge, with little or no foam and no objectionable odor in the aeration compartment. This sludge should settle readily so that the water in the upper part of the final settling compartment will be clear and free of solids, not cloudy or turbid. Should the aeration compartment contents be dark gray or black or have a septic sewage odor, an inadequate air supply would be the cause. With experience, the need for additional air can be accurately gauged by the appearance of the aeration tank liquid.

4) Sludge accumulation on top of settling tank:

- Airlift skimmer not returning.
- Sludge return airlifts not returning, or not returning enough. Check hoppers for sludge build up.
- Excessive amount of grease (check grease trap and clean, if necessary, or eliminate before entering plant).
- Refer to "Sludge Problems" below.

5) Large quantities of solids going over effluent weir:

- Sludge airlifts not returning or not returning enough. Check air lines and airlift tube for blockage.
- Plant overload—check sewage flow and volume and have raw sewage analyzed for B.O.D. and suspended solids.

6) Heavy black sludge on bottom of settling tank:

- Scrape more often.
- Return more sludge by opening needle valve to increase flow to airlift.

7) Large amount of scum on surface (may be due to clog in air line):

- If clogged, rod out line or blow out by shutting off discharge end and opening needle valve.
- Spray surface with water to break up foam and release gas formed bubbles.

SLUDGE PROBLEMS

During the first few weeks of a plant's operation, one of the most common problems is the accumulation of sludge on the hopper slopes of the settling tank. This problem may be almost completely eliminated by proper care and maintenance.

The purpose of the tank is to settle out and separate the solids that pass through from the aeration tank. Normally the liquid in the settling tank should be still to accomplish this purpose. However, one of the characteristics of sludge is that it is likely to be stringy and sticky during the early weeks of plant operation. As it settles toward the bottom of the tank, the hopper slopes are the most convenient place for the stringy, sticky masses of sludge to come to rest.

After a week or so the continuous build-up of sludge will finally become a spongy mass completely filling the lower half of the tank. This will stop the normal movement of sludge to the hopper bottom where it is picked up by a sludge return pipe that returns it to the aeration tank for retreatment. After a short time this spongy mass will form a gas and break up into chunks of sludge that float to the surface of the water. Here, if the condition persists, it will finally become a solid mass again growing

deeper as the sludge builds up from the bottom. Naturally this solid sludge prevents the equipment in the settling tank from performing properly. The skimmer, the froth control pump, and the final discharge weir are all hampered in their operation. In addition, the sludge mass gives off a very strong stench.

Proper preventive maintenance is the best cure for sludge accumulation.

Every day during the first few weeks of operation the operator or some responsible person should visit the plant to see that all equipment is running and to check the settling tank.

A small scraper is used to keep the hopper slopes free from sludge build-up. The hopper slopes begin about three to five feet below the water level. The operator should scrape all around the hopper with a slow, easy downward motion, just enough to help move the sludge toward the bottom of the hopper where it can be picked up by the sludge pump. Do not stir or agitate the sludge roughly or it will break up and rise to the water level. If this happens, the chunks must be dipped back into the aeration tank for further treatment.

This procedure should be followed faithfully until the plant bacteria begin to work properly. This is usually from three to five weeks, depending on the strength of the raw sewage coming into the plant. In almost every case, the above procedure will prevent sludge problems. After the plant begins to "work," the procedure may be reduced to weekly or even monthly as the operator may determine from experience. (The amount of sludge being returned to the aeration tank may be seen by watching the discharge pipe or pipes that empty into the aeration chamber.)

In addition to sludge build-up, there are other associated conditions which need attention. It is possible for a sludge return pipe to be discharing clear water while there is three or four feet of sludge in the hopper. This occurs when soft sludge packs solid almost to the hopper bottom except for a narrow channel running down through the mass to the pump intake. Clear surface water is pulled down through this channel and up through the pump without disturbing the sludge mass. Therefore, visual checking of the sludge return discharge is not sufficient. It is necessary to gently move the mass downward to the pump intake.

Another common condition is a plugged sludge airlift. Sludge, being heavier than water, will normally settle to the hopper bottom. If the sludge pump is not returning at least "one third of a pipe full" into the aeration tank, the slower movement of sludge may allow the sludge to pack in the one-foot square area at the hopper bottom and pump intake. Finally the sludge begins to build up inside the airlift tube until it is blocked completely. This may be remedied by shutting off the air supply to all other equipment and opening the air control valve to the blocked sludge pump. If blockage isn't moved, the three-inch valve should be turned off, causing the air to reverse its direction and back flush the pump. In the absence of a valve, the pipe plug must be removed and the discharge pipe closed at the tee with a shop rag or plumber's stopper to divert the air downward through the vertical pump tube. The great volume of air should break up the solid mass at the pump intake. The chunks that rise to the top must be dipped back into the aeration tank or broken up into small pieces to be returned by the skimmer.

When mud gets into a plant, the part that gets into the settling tank will naturally sink to the hopper bottoms. Here it mixes with the sludge and forms a heavier, more solid mass than sludge alone. The sludge return airlifts will not lift heavy mud. Mud should be removed as soon as it is discovered.

Remember: A clean, properly cared for plant means fewer repairs and maintenance and more efficient operation.

FLOW MONITORING

Flow monitoring includes measurement and sampling of the sewage. Flow measurement requires a primary control device, such as a weir or a flume that has a mathematical relationship between water depth and flow rate. The primary control device is shaped in such a way that by measuring the depth of water flowing through it, a flow rate can be readily determined from a chart or calculated from the formula. Each type and size of weir or flume has its own formula.

Samples of the sewage are taken before and after treatment to determine the efficiency of the treatment plant. All treatment plants that discharge to surface waters are required by the State to sample the effluent prior to discharge. Samples can be single or composite samples. A single sample taken at a specific time is representative of the sewage at the time of collection only. A composite sample consists of a series of single samples taken over a period of time and then combined in a single container. A composite sample represents the average condition of the sewage for the period over which it was collected. Composite sampling can be done on a timed basis, with samples taken at preset time intervals or it can be on a "flow proportion-

ate" basis at preset volume intervals (such as every 1,000 gallons). Many types of meters and samplers are manufactured for use in sewage applications.

The primary control devices require little maintenance other than routine cleaning. Mechanical flow meters and samplers vary widely in complexity and may require the assistance of the manufacturer for repair.

ENVIRONMENTAL PROTECTION

State environmental protection laws typically require that each treatment plant have a least one operator who has direct charge of the operation and makes regular inspection of the plant. This person must have a Certificate of Competency.

In each state, the EPA or equivalent regulatory agency requires regular submissions of operation reports. In Illinois, application forms, operation report blanks and explanatory sheets may be obtained from:

Environmental Protection Agency
Division of Water Pollution Control
2200 Churchill Road
Springfield, Illinois 62706

REFERENCES

The following publications provide more detailed explanations of sewage treatment processes.

1) "Manual of Instruction for Sewage Treatment Plant Operators," New York State Department of Health, Health Education Service, P.O. Box 7283, Albany, New York 12224.

2) "Operation of Wastewater Treatment Plants—A Manual of Practice No. 11," Water Pollution Control Federation, 2626 Pennsylvania Avenue, N.W., Washington, D.C. 20037.

3) "ISCO Open Channel Flow Measurement Handbook, First Edition," Instrumentation Specialties Company, Environmental Division, P.O. Box 5347, Lincoln, Nebraska 68505.

4) "Chlorination of Wastewater—Manual of Practice No. 4," Water Pollution Control Federation, 2626 Pennsylvania Avenue, N.W., Washington, D.C. 20037.

5) "Package Treatment Plants—Operations Manual," Office of Water Program Operations, U.S. Environmental Protection Agency, Washington, D.C. 20460.

Information regarding training programs for wastewater treatment plant operators may be obtained from the following institutions:

Environmental Resources Training Center
Southern Illinois University at Edwardsville
Edwardsville, Illinois 62026

Kirkwood Community College
6301 Kirkwood Boulevard
Cedar Rapids, Iowa 52406

23/Electrical Systems

Maintenance of electrical systems and equipment is necessary for reasons of safety, energy, conservation, and equipment life.

The use of maintenance logs helps keep track of maintenance work. If the records are consistently updated, they can serve as a preventive maintenance tool in establishing trends and anticipating problems. A great deal of electrical energy can be conserved by performing proper maintenance on electrical equipment.

Lighting

Several types of lighting sources are used in school buildings today, in combination with appropriately designed fixtures. These are the fluorescent lamp (hot and cold cathode), incandescent filament lamp, metal hallide, high-pressure sodium, and the mercury vapor lamp.

The fluorescent lamp is the principal interior light source for schools because it produces three times the light and has nine times the life of the same wattage incandescent lamp. Metal hallide and mercury vapor lamps have grown in use for gymnasiums and shops. High pressure sodium lamps are widely used for exterior lighting applications.

There are various color shades of fluorescent lamps, but the two most widely used are the "cool white" and the "warm white." The latter has more red in its spectrum and is more flattering to people and furnishings. When replacing lamps, match those being removed as to type of starting device and ballast, lamp terminals, and color shade.

If a lamp fails to light, the cause may be:

1) **Poor lampholder contact.** Twist gently in the socket. If the lamp flashes, look for a loose lead wire or lampholder part.

2) **Replace** the starter if the lamp is a preheat type.

3) **Burned out lamp.** Check the date installed to see if the lamp has burned its rated life. (Mark the date on all lamps when replacing them.) If the lamp has had a short life, check ballast, starter, and lamp purchase source.

4) **Faulty fixture.** Try the lamp in an operating fixture. If it is okay, check the original fixture for dirt, dust, and moisture accumulation. Also, look for worn lamp holder contacts or defective ballast. (Some ballasts have external fuses; check for blown fuses.)

5) **If the lamp blinks** or flashes it may indicate the end of lamp life, as indicated by darkened ends and reddish glow.

6) **Lamps which** are lit but have long horizontal dark streaks are usually in a cold air path, such as from an air conditioning system. Deflect air away from the lamp and the condition will disappear.

Unless fixtures and lamps are properly maintained and kept clean, a large percentage of the illumination produced is wasted, causing an inefficient use of power. Proper maintenance of a lighting system, therefore, includes cleaning and washing fixtures and lamps as well as surrounding walls and ceilings. (See Procedure 9 in Chapter 9.) It also includes repair and replacement of defective components of the lighting system.

It is important to keep an adequate stock of replacement parts, including lamps, starters, ballasts, sockets and fixtures to match those in service.

CLEANING FIXTURES

With the trend to more complex lighting systems, the time and labor to clean these systems have increased. Fluorescent installations have more fixture area and lamp surface than their incandescent counterparts. The following steps are suggested for cleaning fluorescent fixtures:

1) Clean louvers with two people. The person on the floor receives louvers and cleans them with sponge and detergent. The person on the ladder cleans fixture surfaces. Plastic louvers should be washed, rinsed, and drip dried. Do not wipe dry, as an electro-static charge will form and speed dirt accumulation.

2) Clean lamps at floor level. Use a wash sponge and a separate rinse sponge. Make a downward stroke with the wash sponge in one hand followed by the rinse sponge in the other.

3) Make fixtures shock-free. Either turn off the circuit or use insulating tape to cover the sockets. Dummy lamp bases can also be inserted in the sockets.

4) Brush heavy dirt deposits off the top of the fixture and then wash with detergent.

5) Use a paint brush and detergent around sockets. Use a second brush and rinse water and allow to air dry. Use a wash and rinse sponge for the remainder of the reflector.

Cleaning Compounds for Light Fixtures

Here are some guidelines for cleaning and protecting the various surfaces found on fluorescent light fixtures:

1) **Aluminum:** Use mild soap and cleaners and thoroughly rinse with clean water immediately after cleaning. Do not use strong alkaline cleaners.
2) **Porcelain enamel:** Use non-abrasive cleaners. Detergents and most automobile and glass cleaners are satisfactory.
3) **Synthetic enamel:** Use mild cleaners. Do not allow the fixture to soak in solutions as it may soften. Do not use alcohol or abrasive cleaners. Detergents are satisfactory.
4) **Glass:** Same as porcelain enamel. Use dry cleaners on clear glass panels but not on etched or sand blasted surfaces. Detergents are satisfactory.
5) **Plastics:** Dust is attracted by a static charge developing on plastic. Cleaning twice a year in a detergent will provide satisfactory relief from static dirt accumulations. Destaticizers are available which give a greater protection if desired. Do not wipe plastic dry. After rinsing allow to air dry.

ENERGY CONSERVATION

Energy conservation can be realized on lighting systems whether in a new building, remodeling of existing areas, relamping of existing lighting fixtures and/or ballast replacement. By the use of low energy ballasts and lamps, various percentages can be saved, with a minor reduction in room lighting levels (foot-candles). It is important to check state laws for minimum lighting levels required in schools. Light levels for individual rooms should be logged annually and compared.

For comparison, here is a schedule of low energy components for 40 watt rapid-start lamps and ballasts.

Comparison Item	Lamps		Ballast	
	Standard	Low Energy	Standard	Low Energy
Fixture Watts Based on 4-Lamp Unit	x		168 watts	154 watts
		x	148 watts	134 watts
Relative Lamp Lumens	x		100%	100%
		x	97%	97%
Relative Lumens Output vs. Watt Input	x		100%	100%
		x	110%	121%
Relative Initial Cost per Unit	x		100%	100%
		x	101%	100%
Relative Energy Cost per Unit	x		100%	92%
		x	88%	80%

This chart is based on one 4-lamp fluorescent fixture using one manufacturer's published data. Other manufactured equipment will vary slightly.

A log for keeping track of lamp and ballast replacements is provided in the Management Tools Appendix.

Service and Distribution Equipment

Electrical service and distribution equipment includes low voltage circuit breakers, low voltage fusible units, high voltage switching units, high voltage feeder cables, transformers, and the like. This equipment should be operated, tested and cleaned once a year.

Most school electrical systems are protected by circuit breakers—either molded case breakers or air circuit breakers.

Circuit breakers in lighting panelboards usually are of the plug-in, molded-case, thermal-magnetic type. They compensate for ambient temperatures and will carry full NEC loading (80 percent of rating) in room temperatures as high as 120 degrees F.

When a short-circuit or overload trips a breaker, the operating handle assumes a position midway between "OFF and "ON," identifying the circuit in trouble. When this occurs, check the circuit for the cause of the fault; then switch the handle to "ON" to restore the service.

To maintain panelboards, check all connections once a year for tightness. Keep the interior of the enclosure dry and free of dust. If a unit fails, replace it; the cost is nominal. If breakers open for no apparent reason, check each circuit that terminates in the panel with an ammeter to be sure the load it is carrying does not exceed ratings of the NEC (National Electric Code).

Note: The performance testing of circuit breakers is not a normal maintenance function and should be performed only by qualified, properly equipped personnel.

MOLDED CASE BREAKERS

Molded-case breakers are sealed, reasonably tamper-proof units. In ratings up to 100 amperes, these units are replaced rather than repaired. No extensive maintenance is possible without breaking the factory seal, which terminates the warranty and, in many types of breakers, voids the label of Underwriters Laboratories.

A qualified electrician should test all such breakers under load for calibration and positive operation at least once a year. Unless a breaker is operated occasionally, manually or electrically, it can become inoperable through disuse. If not electrically operated for extended periods, the internal mechanisms and linkage may become stiff and prevent the breaker from tripping even if three or four times the rates current is applied. Once operated, however, the breaker in most instances will be found to be serviceable.

Electrical testing under load will quickly indicate whether both the magnetic and thermal trip elements are functioning properly.

AIR-CIRCUIT BREAKERS

Checks twice yearly of this heavier switchgear are recommended. A special check should be made after each interruption of a heavy short-circuit current. If a breaker is kept in either an open or closed position for long periods, it should be opened and closed several times at periodic intervals to insure continuing and proper operation.

Caution: Before inspecting or adjusting any breaker, make sure that all service to the breaker is dead and that the breaker is completely disconnected from any bus or line. Check the grounding connection on the frame to be sure it is intact. Finally, temporarily ground all breaker studs and current-carrying parts during the inspection.

ANNUAL INSPECTION

1) **Check contacts** for cleanliness. Check arcing contacts and if pitted or burned, dress or replace. Do not attempt to repair laminated contacts that are badly burned or pitted; replace them.

2) **Check terminal** connectors for overheating. Make sure they are mechanically tight.

3) **On mechanisms,** check all nuts and bolts to be sure that they are in place and tight and that no pins or cotter pins have fallen out. Check all moving parts for binding. Operate breaker several times for functioning of all parts. Lubricate bearing points lightly.

4) **Check to be sure** that all parts of the tripping device and trip latch move freely and that the armature of the overcurrent trip device has sufficient travel to release the breaker latch.

5) **Check the** load current against the breaker rating.

6) **Check the control** switch and the closing relay for proper operation. Replace any burned-out indicating lamps.

7) **Check the mechanical** condition of the enclosure. Make sure the operating handle is not blocked in any way. Make sure the ground connection of the enclosure is mechanically intact.

8) **Check the positive** tripping of undervoltage devices. If equipped with a dashpot, make sure the dashpot is clean.

Fusible equipment is reasonably maintenance free as far as electrical protection is concerned, providing the proper type of fuse is being used in the various circuits. However, every switch has a mechanical operator, and it should be operated, cleaned, checked and lubricated annually to insure reliability.

High voltage switching equipment, high voltage cables and transformers should be tested only by qualified testing organizations and should be done annually. The testing organizations will provide written reports, graphs, and logs on the condition of this equipment.

Caution should be noted on distribution systems utilizing aluminum conductors. Aluminum conductors terminated directly into the lugs of circuit breakers or fusible switches will loosen to various degrees. These cable terminations should be tightened annually or preferably changed to a bi-metal lug type with crimp sleeve or some other suitable type of termination.

These aluminum connections can cause extensive electrical failures and damage to equipment if not maintained.

Motors and Controls

Motors and control equipment should be thoroughly inspected and cleaned once a year.

Warning: Turn off power ahead of the starter before performing any of the following operations. Check incoming line terminals with a voltmeter to ascertain positively that the equipment is totally de-energized. Also, note that many magnetic starters have control voltages derived from sources separate from starter terminal voltages. It is imperative that both power sources be de-energized prior to inspection of the starter.

Inspect starters once each year or after any severe electrical fault. Look for any moisture or signs of previous wetness or dripping inside the starter. Condensation in conduits or dripping from outside sources is a common cause of starter failure.

If there is an appreciable accumulation of dust and dirt, clean out the starter by using a brush, vacuum cleaner, or clean lint-free rags. In order to avoid blowing dust into other equipment, do not use a blower or compressed air.

Carefully inspect all visible electrical points and terminals in the electrical wiring systems. Retighten them if there is any sign of overheating or looseness. If joints or terminations appear to be badly discolored, corroded or pitted, or show signs of having been subjected to high temperatures, the parts should be disassembled and replaced or cleaned.

Examine fuse clips in combination starters. If there is any sign of overheating or looseness, check the spring pressure and tightness of the clamps. Replace the fuse clips if the spring pressure compares unfavorably with that of other identical fuse clips. Be sure that the condition which caused the overheating has been corrected.

Check all devices for missing or broken parts, proper spring tension, free movement, rusting or corrosion, dirt, and excessive wear.

Clean off oil and sooty deposits. Replace contacts if appreciable material has burned away or if material is charred or pitted. (Contact erosion is the most common cause of starter failure.) When replacing contacts, also replace contact pressure springs.

Check thermal overloads and fuses (in combination starters) to make sure they have the proper ampere rating and interrupting rating. Never attempt to defeat the rejection mechanism which prevents the installation of the wrong type of fuse.

Motors used for driving mechanical systems, such as exhaust fans, air handling units, or pumps, consume a large part of a school's electrical energy. These systems should be turned off when the building is either fully or partially unoccupied. The installation of a simple time clock (24-hour with seven-day dial) on each of the systems would allow automatic shut-down and start-up during unoccupied periods. For example, a 10-horsepower air handling unit shut down from 5:00 p.m. to 7:00 a.m. would save 140 kilowatt hours a day.

Caution: Do not shutdown mechanical systems that would allow water in the building to freeze during unoccupied periods.

While doing annual maintenance on motor control equipment, comparing the operating current (amps) of the motor on the circuit with the readings taken in previous years and with the motor nameplate full load amps will provide a

quick indication of motor operation. Operating amperages higher than previous years may indicate bad bearings, belt problems, or other malfunctions in the various types of mechanical systems.

A typical log for keeping track of motor control and motor maintenance is provided in the Management Tools Appendix. The table on pages 186 and 187 lists troubles encountered with motor controls, their causes and remedies.

Fire Alarm Systems

A fire alarm system must be both electrically and mechanically secure. This means that all devices, as well as the operating power, must be supervised. The fire alarm system should be tested at least monthly by:

- Disconnecting a signal
- Disconnecting a station
- Disconnecting a detector
- Disconnecting the operating power

When any of these is done, the trouble bell must ring.

Signals can be tested by operating a test button or activating a station.

Heat detectors can be tested by putting a warm damp cloth around the detector for about one minute or by using a portable hair dryer. Rate-of-rise detectors will actuate if the temperature is raised 15 degrees F. in one minute. Fixed-temperature detectors will operate only at the rated temperature; when the temperature reaches this point the solder melts and closes the electrical contacts. Hence, any test will destroy the detector.

Do not test a detector with a lighted match or other open flames, because this will melt the solder.

On the so-called smoke detectors, the method of testing and maintenance is different. These usually are made so that the dirtier they get the faster they will fire or activate. This means that their screens must be cleaned at regular intervals, depending on the location, usually once or twice a year. Detectors of the radioactive type must be given a wipe test every three years after the date of installation.

On stations of the coded type, which send out several rounds of code, there is a test key that provides for a "silent test." By inserting the key and operating the station, the movement goes through its rounds without sending an alarm. On stations of this type, there is a key for making single-tap tests on the system. Operation of the key causes the alarm bells to tap one stroke, indicating the alarm system is intact.

On fire alarm systems of the annunciated type there should be a means of testing the lamps. On most annunciators there is a test button which lights all the lamps once, revealing any defective or burned out lamp.

Systems which are connected to municipal fire alarm systems should be disconnected during local tests, so that alarms do not go into the municipal system. However, with the assistance of the fire department, the municipal system should be checked regularly for reliability.

While testing for both circuit supervision and system operation (signals or alarm actuation device), different devices in various locations should be used each time.

An on-going log of tests will insure proper equipment and system operation. The log for each test should include the following information:

- Date of test.
- Supervision test: Devices disconnected (location and type).
- System operation test: Devices operated (location and type).
- Power supply supervision test: (normal or malfunction).

Magnetic Contactors and Starters

Trouble	Cause	Remedy
CONTACTS		
Contact chatter	1) Broken shading coil.	1) Replace magnet and armature.
	2) Poor contact in control circuit.	2) Replace the contact device or use holding circuit interlock (3 wire control).
	3) Low voltage.	3) Correct voltage condition. Check momentary voltage dip during starting.
Welding or freezing	1) Abnormal inrush of current.	1) Check for grounds, shorts or excessive motor load current or use larger contactor.
	2) Rapid jogging.	2) Install larger device rated for jogging service.
	3) Insufficient tip pressure.	3) Replace contacts and springs, check contact carrier for deformation or damage.
	4) Low voltage preventing magnet from sealing.	4) Current voltage condition. Check momentary voltage dip during starting.
	5) Foreign matter preventing contacts from closing.	5) Clean contacts with freon. Contactors, starters, and control accessories used with very small current or low voltage should be cleaned with freon.
	6) Short circuit.	6) Remove short or fault and check to be sure fuse or breaker size is correct.
Short contact tip life or overheating of contact tips	1) Filing or dressing.	1) Do not file silver tips. Rough spots or discoloration will not harm tips or impair their efficiency.
	2) Interrupting excessively high currents.	2) Install larger device or check for grounds, shorts, or excessive motor current draw.
	3) Excessive jogging.	3) Install larger device rated for jogging.
	4) Weak tip pressure.	4) Replace contacts and springs, check contact carrier for deformation or damage.
	5) Dirt or foreign matter on contact surface.	5) Clean contacts with freon.
	6) Short circuits.	6) Remove short or fault and check to be sure fuse or breaker size is correct.
	7) Loose connection.	7) Clean and tighten.
	8) Sustained overload.	8) Check for excessive motor load current or install larger device.

Trouble	Cause	Remedy
COILS		
Open circuit	1) Mechanical damage.	1) Handle and store coils carefully.
Roasted coil	1) Over voltage or high ambient temperature.	1) Check application, circuit and current. Replace coil.
	2) Incorrect coil.	2) Install correct coil.
	3) Shorted turns caused by mechanical damage or corrosion.	3) Replace coil.
	4) Under voltage, failure of magnet to seal in.	4) Correct system voltage.
	5) Dirt or rust on pole faces increasing air gap.	5) Clean pole faces.
OVERLOAD RELAYS		
Tripping	1) Sustained overload.	1) Check for grounds, shorts, or excessive motor currents and correct cause.
	2) Loose connection on load wires.	2) Clean and tighten.
	3) Incorrect heater.	3) Heater should be replaced with correct size.
MAGNETIC AND MECHANICAL PARTS		
Noisy magnetic	1) Broken shading coil.	1) Replace magnet and armature.
	2) Magnet faces not mating.	2) Replace magnet and armature.
	3) Dirt or rust on magnet faces.	3) Clean. Replace if rust is excessive.
	4) Low voltage.	4) Check system voltage and voltage dips during starting.
Failure to pick-up and seal	1) Low voltage.	1) Check system voltage and voltage dips during starting.
	2) Coil open or shorted.	2) Replace
	3) Wrong coil.	3) Replace
	4) Mechanical obstruction.	4) With power off check for free movement of contact and armature assembly.
Failure to drop-out	1) Gummy substance on pole faces.	1) Clean pole faces.
	2) Control circuit continues to be energized.	2) Check coil circuit.
	3) Worn or rusted parts causing binding.	3) Replace parts.
	4) Residual magnetism due to lack of air gap in magnet path.	4) Replace magnet and armature.

24/Food Service Equipment

Kitchen Machinery

All kitchen machinery food contact surfaces must be washed and sanitized at the end of each day's use. If the surface is small enough to be placed into the dishwasher, it will be sanitized assuming the dishwashing machine is working properly. Otherwise, the food contact surface, after it is cleaned, must be rinsed with a 100 parts per million chlorine rinse solution. All food service equipment must be lubricated with food safe lubricants.

DISHWASHERS

Complete the following procedures daily.

1) Before each use:

- Check temperature of all thermometers. If they are under or over the proper temperature, adjust or repair *before* the dishwasher is placed in service. The temperatures must be at the proper level; if not, an emergency exists and all eating utensils must be sanitized with a 100 parts per million chlorine rinse or single service utensils used.
- Check pressure guage. The pressure on the rinse line must never be above 20 p.s.i.

2) Turn off booster heater.

3) Open all doors of machine and remove all manifold end cap assemblies.

4) Check all manifold nozzles for obstructions and clean as necessary.

5) Close door and flush machine by briefly operating the dishwasher.

6) Open all drains.

7) Clean off soiled and clean dish tables and rinse into dishwasher.

8) Remove and clean all strainer pans.

9) Remove curtains and wash out interior of the machine; open all doors and allow machine to dry.

Most electric motors have grease plugs. Remove plugs and lubricate about twice a year. Do not over lubricate. Pumps do not need lubrication.

Replenish lubricant in speed reducer as needed. Check monthly. Every six months remove plugs and drain the lubricant. Replace plugs and refill with new lubricant. Be sure that the vent hole in the plug is kept open.

Clean and wash arms and check for obstructions in nozzles daily.

DISPOSERS

Run disposers for five to ten minutes after daily use in order to clear all waste lines properly. If possible, use hot water.

Annually, check cutting teeth, cutting ring, cutting bowl, and cutting bars for wear. Replace as necessary.

Motors are permanently grease packed and do not require lubrication.

PEELERS

Ball bearings and motors are generally sealed and require no lubrication.

Replace peeling disc when needed. It should last several years.

Check door gasket monthly for leaks. Replace if

needed.

Annually have a local service agency inspect and check the operation of this unit.

Run peelers five to ten minutes after daily use.

MIXERS

General: All exterior surfaces should be wiped clean with a hot damp cloth daily. A mild soap solution may be used.

Apply a small amount of mineral oil to the bowl slideways monthly.

Mixing bowls should be scrubbed with hot water and a soft bristle brush after mixing has been completed. Wash all agitators and mixer shafts in hot water. Flush mixer bowls with hot water immediately after mixing products which contain sugar to prevent metal discoloration and pitting of tinned surfaces.

5, 10, 20 and 30-quart series: These units will have their motors grease packed so they will require very little attention. The transmission gearing is packed with grease which will last several years.

Lubricate the bowl lift with one or two drops of oil monthly. Remove the drip cup monthly and wipe it clean.

60 and 80-quart series: Wash all agitators and mixer shafts in hot water; then if possible, place them in the dishwasher for sanitation. Otherwise, wipe all food contact surfaces with a 100 parts per million chlorine rinse.

The agitator shaft bearings are sealed and do not usually require attention. If greasing becomes necessary the local service agency should do it.

The lift screw, gearing mechanism and slideways should be greased annually. The drip cup should be removed and cleaned monthly.

The rear bearing is grease packed and should require no attention. If greasing does become necessary, the local service agency should perform this procedure. Check the oil level in the transmission and in the planetary gear weekly.

Have a local service agency inspect and check the operation of these units annually.

When the mixer bowl surface is worn or pitted, have the bowl retinned.

SLICERS

Motors and bearings are grease packed and require no attention.

Semi-annually, oil should be added to the carriage slides, rod wicking pads and slice thickness gauge.

Sharpen knife as required. Keep honing stone free from grease by washing periodically.

Have a local service agency inspect and check the operation of these units annually.

FOOD CHOPPERS

Motors and bearings are grease packed and require no attention. Operate the unit only with food in the bowl to avoid damage to the running knife and plate.

Inspect drain hole periodically to make sure it is clear. If clogged, open with a pin or paper clip.

FOOD CUTTERS

The machine has sufficient lubrication when it leaves the factory. Check lubricants before placing the machine in operation.

The knife assembly should be removed as a unit for cleaning. Check knife clearance monthly and make necessary adjustments. Refer to the manufacturer's instruction book for the proper method.

Check lubricant in the bowl drive gear case and the attachment drive gear case each month.

Annually, have this unit inspected by the local service agency. Clean this unit daily with a damp cloth and a mild detergent.

BOOSTER HEATERS

Weekly, turn off electric power to booster heater and drain unit to remove scale in the bottom of the tank. Refill with water before restoring power.

SELF-LEVELING DISPENSERS

General: Before cleaning units, remove all contents. Disconnect electrical power to all heated models and allow to cool.

Drop-in units: Lubrication of this mechanism is not necessary. Remove unheated models from the counter, wash with warm soapy water, flush out through drain holes, dry and replace. Do not immerse heated models in water.

Mobile units: Lubricate link-chain and sprocket or lowerator type mechanism on all models every six months with light machine oil on a clean cloth. Lubricate caster swivels once a year with light machine oil.

Vacuum out spring chamber or brush dirt, dust etc., out through clean-out slot at base of unit.

CARTS AND RACKS

Lubricate caster swivels once a year with light machine oil. Clean all carts and racks daily with hot water and mild soap.

Cooking Equipment

The service connections on all gas fired, movable cooking equipment must be checked for leaks regularly, especially when the units are moved for cleaning or maintenance.

RANGES

General: All ranges should be given a general check up annually. The exterior should be washed daily with a mild soap and water and dried with a clean cloth.

Be sure doors close snug and tight. Carefully clean all crumbs and encrusted matter from around oven door openings so door will seal properly. To be sure that all doors will continue to seal properly, do not slam or stand on doors.

If correct by-pass flame on gas ranges cannot be obtained, dirt is probably holding the main control valve partially open. To clean, turn off main gas cock, unscrew cap assembly, and carefully wipe disc and seat in valve. Replace cap assembly and tighten securely.

Open Tops: After top grids are entirely cooled, soak in water and a good grease solvent, first removing foreign particles by brushing with a stiff brush. This procedure should be completed daily or as necessary.

Hot Tops: After top plates have cooled somewhat, rub vigorously with heavy burlap or steel wool. Remove any grease or dirt lodged under flanges, lids or plates. This procedure should be completed daily or as necessary.

Grates and Open Burners: Brush burner head with a staff wire brush. Clean clogged ports with stiff wire or ice pick. This procedure should be completed daily or as necessary.

OVENS

General: All ovens should be given a periodic general check up. Lint and grease suspended in the air tend to collect in passages. Therefore, all flues, burner parts, primary air openings, etc., should be periodically cleaned to prevent clogging.

The exterior should be washed with a mild soap and water solution daily, and dried with a clean cloth.

The interior should be cleaned daily. Remove racks. A scraper, wire brush or steel wool may be used on hard accumulations. Caution should be used when using abrasives on "self-cleaning" surfaces. Commercial oven cleaners can be used but special care should be given to thoroughly drying afterwards.

For seasonal shut-downs, clean as suggested above. Use a mineral oil on all interior surfaces. If possible, keep pilot light lit. Prior to starting after seasonal shut-down, wipe all clean surfaces with a clean cloth.

Range Ovens: Remove boil-overs and spill-overs daily before materials have time to harden or carbonize. Be sure oven exterior is cool before cleaning. Prop the door open slightly until chamber cools; moisture and odor will quickly disappear. Wipe oven bottom and lining with a damp (not wet) cloth. Brush off encrusted materials.

Never throw water on oven decks to cool them. In extreme cases a commercial oven cleaner may be applied to porcelainized areas only.

Convection Ovens: Wait until oven cools, then remove racks and guides and clean as mentioned above under "Range Ovens."

The fan and blower shield should be cleaned weekly by removing the back panel. Refer to your instruction manual for proper removal procedures. Fan motors do not require lubrication. Check for proper operation semi-annually.

Check door gaskets periodically for loss of heat due to the collapse of the gaskets. Replace if necessary.

Have the factory service agency check the controls and thermostats semi-annually for accurate temperature calibration.

Stack or Deck Ovens: Follow the same procedures outlined under "Range Ovens."

Microwave Oven: Clean all interior surfaces daily with a damp cloth and wipe dry. Clean all exterior surfaces with warm water and a mild detergent. Do not allow food particles to collect on interior surfaces and door.

Check the door seal and hinges for tightness. If there is any indication of a loose seal, shut unit down and contact the local service agency for repair. Do not operate the unit with an improper seal.

Remove air intake filter weekly and wash in hot water in the dishwater.

Controls should be inspected semi-annually for calibration and accuracy by the proper service agency.

STEAM KETTLES

After use, kettles should be filled immediately with warm water and mild detergent and should be washed with a nylon kettle brush.

Tilting mechanism joints should be lubricated monthly. Valves should be checked semi-annually for possible leaks.

STEAM COOKERS

Remove all shelves and uprights and wash them in mild detergent and warm water daily. Clean interior and exterior daily with a mild detergent solution and warm water.

The fuel supply to the unit should be turned off at the end of each day's operation.

Check the door gasket weekly and replace when necessary. Lubricate the door hinges monthly. Leave doors open slightly when not in use.

Controls and valves should be checked semi-annually by a qualified service agency.

STEAM GENERATORS

Check the water level gauge frequently, but at least once a day. The proper water level must be maintained. The fuel supply to the unit should be turned off at the end of each day's operation.

Once or twice a week, drain boiler while it is at operating pressure in order to flush out any sediment which may have formed in the unit.

Major boiler cleaning should be done two or more times per year depending upon local water conditions and also prior to prolonged shutdown.

This cleaning proceudre should be accomplished according to the manufacturer's step-by step instructions.

Valves should be checked monthly for proper operation and possible leaks.

BROILERS

Empty grease drawer, scrape drip pan and grease hopper daily. Rods may be removed and left to soak over night in water to loosen material build-up.

Clean all exterior surfaces with warm water and detergent daily. Clean all interior surfaces of the broiling compartment thoroughly at least once a week. Use a long handled scraper and soft brush to loosen stubborn food particles.

Controls should be checked semi-annually by a qualified service agency.

FRYERS

Drain and filter fat daily. Clean the pot and heating elements with a stiff brush.

On electric fryers, lift the calrod or heating element to a partially raised position and allow it to drain thoroughly. Then lift the element to the fully raised position and turn on fryer. Let the elements heat for two minutes at 400 degrees F. to allow them to burn clean. Brush carbon from the elements with a soft brush. Perform this operation weekly.

Controls and thermostats should be inspected semi-annually for calibration and accuracy by the proper service agency.

GRILLS

Scrape top with spatula or scraper to keep surface free of encrusted food during use. Wipe frequently with a heavy absorbent cloth. After griddle is cool, polish with griddle stone and mild detergent weekly. Turn down burners during slack periods, and do not overheat.

Controls and thermostats should be inspected semi-annually for calibration and accuracy by a qualified service agency.

Other Food Service Equipment

VENTILATORS

General: Wipe and clean all exposed surfaces daily to remove grease before it has a chance to harden on the surfaces.

The interior of the ventilator should be cleaned periodically depending on local codes, usage, and soil accumulation.

A good grade of non-toxic stainless steel polish should be applied to stainless steel surfaces to maintain and protect the original finish.

On ventilators with grease cups, daily inspection is required. Keep this cup empty and clean to prevent overflowing.

Wire Mesh Type Ventilator: Remove all filters from hood weekly, soak them in hot water and run them through the dishwashing machine. Let filters dry overnight before reinstalling them in the ventilator.

Clean all interior surfaces of the ventilator, particularly behind the filter bank before replacing the filters.

Baffle Type Ventilator: Remove baffles from hood, and clean by running them through the dishwasher, hand scrubbing in a pot sink or steam cleaning.

Since baffles are self-draining, the grease collection cap should be checked often and kept empty.

Clean interior surfaces behind baffles before replacing.

Detergent Wash Down Type Ventilator: Approximately every 300 hours of operation of the detergent pump, open the oil plug at the top of the motor and apply four drops of high temperature oil. Check the foot valve at this time to make sure that the suction screen is not clogged. The foot valve is located in the detergent tank on the end of the suction tube.

Detergent wash systems should be activated daily to keep all baffles free of grease. Check detergent tank weekly to insure that it has not run dry.

Fire Protection Systems: All extinguishers should be checked periodically depending on local code requirements. Check the local fire codes in your area.

REFRIGERATORS

General: Check temperature of all thermometers daily. Cooler thermometer must indicate a temperature of 45° F. or less. Freezer thermometer should indicate a temperature of —10° F.

Walk-In Cooler/Freezers: Check the oil level in the compressors weekly and check the sight glass for color change. If there is a noticeable change, there is moisture in the refrigeration lines. Notify the local service agency if this occurs.

Every six to eight weeks clean dust and dirt off compressors and cooling coil.

General cleaning of walls and floors should take place weekly.

Reach-In Refrigerators/Freezers: The entire refrigerator interior and exterior should be cleaned thoroughly each week. If any spillage of foods occurs, that portion of the cabinet should always be cleaned immediately. Keep door gasket clean and free from grease. The gasket should be wiped clean with lukewarm water and mild soap once a week.

Motors are hermetically sealed with a lifetime oil supply. No lubrication is necessary.

The condenser radiator should be cleaned by brushing or vacuuming lint and dust away from unit semi-annually.

Ball bearing rollers on self-closing doors should be oiled monthly.

Check door gaskets monthly for leakage. Replace when necessary.

All refrigeration and electrical adjustments should be made by a qualified local service agency.

Ice Machines: The condensing unit blower coil should be cleaned of dirt and lint three or four times a year. Semi-annually complete the following procedures:

1) Clean evaporator, hot water tank, sump pump and screen.
2) Tighten all electrical connections.
3) Tighten all bolts.
4) Check water supply and pressure flow control.
5) Clean water strainer.
6) Oil drive motor at oil cup points.
7) Oil condenser fan motor if oil cups are provided.
8) Check for refrigerant and water leaks.
9) Tighten drain line connections.
10) Check bin thermostat setting for conformance to manufacturer's specifications.

If leaks have developed or major adjustments must be made, contact a qualified service agency.

GENERAL MAINTENANCE

Stainless Steel

The same basic procedures are used in cleaning stainless steel equipment, regardless of the equipment's function. With soft food, dirt and grease, the best procedure is to remove deposits from the surface as soon as possible to avoid having them baked on or dried on. Use soap, detergent, or ammonia and water. If deposits of this type are removed promptly and regularly, nothing more than cloth, fiber brush, or sponge will be needed in most cases.

When food and grease deposits are more stubborn, treat hard-to-clean areas with a cloth soaked in ammonia and water. Leaving the cloth in place for 10 to 15 minutes while other chores are done will usually make the deposits easy to remove.

Stubborn, baked-on deposits can't always be avoided, and usually occur when spills burn on, or cleaning is neglected for a day. In such cases, when scouring becomes necessary, observe these guidelines: deposits will come off easier if rubbed in the same direction as the polish lines on the metal, and rubbing in this manner avoids the possibility of marring the appearance of the surface. Use as

little pressure as necessary. Scrapers and cleaning instruments should be stainless steel, wood, plastic, or hard rubber, and only stainless steel wool should be used.

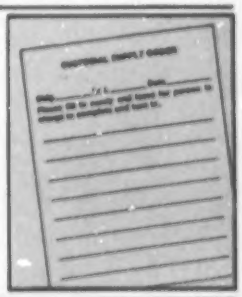
Common steel wool, wire brushes, files, or other non-stainless steel tools may leave particles of iron imbedded in the stainless steel surface, which may themselves rust and cause stains. An excellent cleaning paste for stainless surfaces may be made by adding magnesium oxide, finely powdered pumice or French chalk to a solution of ammonia and water. When using this or any other abrasive cleaner, use the finest grit capable of doing the job.

After scouring, always wash equipment with detergent, soap or ammonia and water. Also, be sure to remove all cleaning materials with a thorough rinse of clean potable water.

Summer Maintenance

It is recommended that all food service equipment be annually serviced during the summer months. When school begins, all equipment will be ready to operate. A local qualified service agency should be able to solve all equipment problems in one or two service calls at a reasonable cost.

Section Six
MANAGEMENT TOOLS APPENDIX



Cleaning and General Building Services

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WORK SHEET—DETERMINING FREQUENCIES FOR CLEANING AND SERVICES

Use the legend below to indicate how often each task must be performed in each area of the school.

AREAS / TASKS	Automatic Power Scrubbing	Chemical or Acid Spills	Chalkboard Cleaning	Dispenser Servicing	Dry Mopping	Dusting	Graffiti Removal	Interior Glass Cleaning	Light Fixture Cleaning	Plumbing Fixture Cleaning	Wall Washing	Wet Mopping	Waste Removal	Waxing Furniture	Soft Floor Refinishing	Hard Floor Refinishing	Carpet Vacuuming	Carpet Periodic Care	Exterior Window Washing	Sweeping
Cafeteria																				
Classrooms																				
Corridors																				
Entrances																				
Gymnasiums																				
Laboratories																				
Library, Music Room																				
Locker/Shower Rooms																				
Offices																				
Restrooms																				
Shops																				
Stairways																				
Swimming Pool																				

5W—Five times a week
4W—Four times a week
3W—Three times a week
2W—Twice a week
1W—Once a week

3M—Three times a month
2M—Twice a month
1M—Once a month
Q—Quarterly
SA—Semi-Annually

A—Annually
A3—Every three years
A5—Every five years
AN—As needed
AU—After every use
VP—During vacation periods

CUSTODIAL AREA ASSIGNMENT

TO: _____ _____ _____

Building Time Allotted

General description of area to be serviced:

_____

_____

It is intended that each written assignment and the periodic cleaning schedule provide a full eight hours of work. If this assigned area fails to include enough work to keep busy, contact the person in charge immediately and the situation will be corrected. Periodic cleaning such as waxing furniture is not covered in this written assignment, but it is the responsibility of the custodian to see that all periodic cleaning is accomplished.

The assignment details the work and, under normal conditions, the time the work is to be performed. Supervision may find it necessary from time to time to adjust the assignment. If there are any questions, please discuss them with the person in charge.

As members of the custodial team, each individual is expected to do the best job he or she can. Your job will be easier when you enjoy and receive satisfaction from your work and have a friendly feeling for the people you meet and work with.

Supplies and equipment are in Rooms _____, _____, _____, _____, _____, _____.

TASKS OR COMBINATION OF TASKS	HOURS From	To
1. _____		
_____	_____	_____
2. _____		
_____	_____	_____
3. _____		
_____	_____	_____
4. _____		
_____	_____	_____
5. _____		
_____	_____	_____
6. _____		
_____	_____	_____
7. _____		
_____	_____	_____
8. _____ _____		
_____	_____	_____
9. _____		
_____	_____	_____
10. _____		
_____	_____	_____

Miscellaneous:

a. Perform periodic cleaning.
b. Keep custodial areas, equipment and supplies neat, clean and orderly.
c. Remove ice and snow from entrances.
d. Report repairs needed.
e. Clean bulletin board glass and all inside glass in your area excluding exterior windows.
f. Turn out all unnecessary lights.

Date_____ Approved _____

CUSTODIAL INSPECTION REPORT

FLOOR MAINTENANCE

Date_____

Crew Inspected

_____ Name _____ Name _____ Name

Building_____ Location No._____ Areas Inspected_____

Floor Type_____ Floor Condition: ☐ Good ☐ Fair ☐ Poor

Condition of Finish: ☐ Good ☐ Fair ☐ Poor ☐ Bad

I. Procedure Used

Dust mopping ..... ☐
Dry cleaning ..... ☐
Cleaning w/finish ..... ☐
Renovating ..... ☐
Water mopping ..... ☐
Machine scrub ..... ☐
Auto scrub ..... ☐
Water pick-up ..... ☐
Mop & bucket ..... ☐
Water vac ..... ☐
Rinsing ..... ☐
Seal: 1 coat ..... ☐
2 coats ..... ☐
3 coats ..... ☐
Brand_____
Finish: 1 coat ..... ☐
2 coats ..... ☐
3 coats ..... ☐
Brand_____

Cleaner Used:
Brand_____

II. Equipment

	Condition		
	Clean		Needs Replacement
Dry mops	☐	☐	☐
Wet mops	☐	☐	☐
Mop Units	☐	☐	☐
Floor machine	☐	☐	☐
_____	☐	☐	☐

III. Work Evaluation 1—Unsatisfactory 2—Marginal 3—Average 4—Above average 5—Outstanding

Quality of Finished Floor —1—2—3—4—5

Streaking	☐ Yes	☐ No
Caused by	☐ Products	☐ Employees
Splash mark	☐ Yes	☐ No
Lap marks	☐ Yes	☐ No
Clean baseboards	☐ Yes	☐ No
Void spots	☐ Yes	☐ No
Built-up	☐ Yes	☐ No
Powdering	☐ Yes	☐ No

IV. Personnel Evaulation — Evaluate each crew member annually on the "Work Appraisal" Form.

V. Verbal Summary _____

_____

_____

I Approve - Disapprove This Evaluation _____ Supervisor

CUSTODIAL INSPECTION REPORT

WINDOW MAINTENANCE

_____ Date

I. Crew Inspected _____ Name _____ Name _____ Name _____ Name

_____ Name _____ Name _____ Name _____ Name

II. Building _____ Loc. No. _____ Areas Insp. _____

A. Window Washing (Condition of Windows: Heavy soil ☐ Avg. soil ☐ Light soil ☐)

1. Procedure Used
   - Belts ☐
   - Window pole ☐
   - _____ ☐
   - _____ ☐

2. Equipment
   - Buckets ☐
   - Sponges ☐
   - Cheesecloth ☐
   - Squeegee ☐
   - _____ ☐
   - _____ ☐

3. Supplies
   Cleaner used:
   - _____ ☐
   - _____ ☐
   - _____ ☐
   - _____ ☐
   - _____ ☐

4. Condition of Supplies and Equipment

	Adequate	Inadequate	Dirty	Clean	Needs Replacement
Equipment	☐	☐	☐	☐	☐
Supplies	☐	☐	☐	☐	☐
Belts	☐	☐	☐	☐	☐
Ladders	☐	☐	☐	☐	☐

B. Dusting (Condition of Venetian Blind: Heavy soil ☐ Avg. soil ☐ Light soil ☐)

1. Procedure Used
   - Vacuuming ☐
   - Washing ☐
   - _____ ☐

2. Equipment
   - Back vac. ☐
   - Vacuum ☐
   - Duster ☐

3. Supplies
   - _____ ☐
   - _____ ☐
   - _____ ☐

4. Condition of Equipment and Supplies

	Adequate	Inadequate	Dirty	Clean	Needs Replacement
Vacuum	☐	☐	☐	☐	☐
_____	☐	☐	☐	☐	☐
_____	☐	☐	☐	☐	☐

III. Work Evaluation (1 - Unsatisfactory, 2 - Marginal, 3 - Average, 4 - Above Average, 5 - Outstanding)

1. Quality of Finished Work 1 - 2 - 3 - 4 - 5 (Circle one)

Streaky windows	☐ Yes	☐ No
Blind dusting	☐ Adequate	☐ Inadequate
_____	☐ Accidents	☐ No accidents

2. Individual Evaluation—Evaluate each crew member annually on the "Work Appraisal" Form.

IV. Verbal Summary: _____

_____

_____

_____

_____

_____ Inspector

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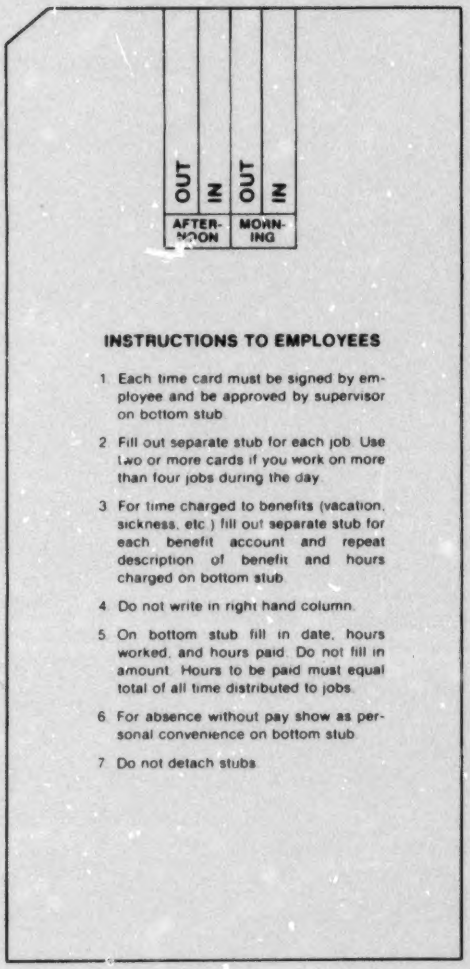
I Approve - Disapprove This Evaluation. _____ Supervisor

TIME REPORT (FRONT & BACK)



OUT	IN	OUT	IN
AFTER-NOON		MORN-ING	

INSTRUCTIONS TO EMPLOYEES

1. Each time card must be signed by employee and be approved by supervisor on bottom stub.
2. Fill out separate stub for each job. Use two or more cards if you work on more than four jobs during the day.
3. For time charged to benefits (vacation, sickness, etc.) fill out separate stub for each benefit account and repeat description of benefit and hours charged on bottom stub.
4. Do not write in right hand column.
5. On bottom stub fill in date, hours worked, and hours paid. Do not fill in amount. Hours to be paid must equal total of all time distributed to jobs.
6. For absence without pay show as personal convenience on bottom stub.
7. Do not detach stubs.

Description of Job				
Employee No.	Date		Hours	
Work Order	Job No.	Location		
Description of Job				
Employee No.	Date		Hours	
Work Order	Job No.	Location		
Description of Job				
Employee No.	Date		Hours	
Work Order	Job No.	Location		
Description of Job				
Employee No.	Date		Hours	
Work Order	Job No.	Location		
Date	Hrs. Wk.	Rate	Hrs. Pd.	Amount

Time Charged to Benefits

Emp. No. | Name

Approved by _____
Supervisor

CUSTODIAL AREA SANITATION REPORT

Building _____

_____ Custodian Date _____ 19_____

KEY

DI—Dirty
DU—Dusty
S—Smeared or Stained
L—Littered
WX—Needs Wax
CW—Cobwebs
O—Organization
R—Repair Needed
WA—Needs Washing
SV—Service Needed
✓—Satisfactory

Item	Room No. or Area					Item	Room No. or Area				
Mirrors						Door Glass					
Shelves						Transoms					
Soap Dispensers						Blackboards					
Sinks						Chalktrays					
Towel Cabinets						Erasers					
Supplies						Tables					
Sanitary Cabinets						Book Cases					
Urinals						Desks					
Toilet Bowls						Desk Lamps					
Toilet Paper						Ash Trays					
Tile/Marble						Telephones					
Furniture						Chairs					
Equipment						File Cabinets					
Metal Partitions						Smoking Urns					
Waste Cans						Steps/Stairs					
Floors						Handrail					
Radiators						Drinking Fountains					
Window Ledges						Bulletin Boards					
Woodtrim						Pipes/Ducts					
Baseboards											
Rest Room Doors											

Use reverse side for any additional comments.

This Report Has Been Discussed With Me.

_____
Custodian's Signature

(Over)

Area Sanitation Report *continued*

Building

Custodian

PROBATIONARY ☐

CERTIFIED ☐

ADDITIONAL COMMENTS:

UNACCEPTABLE ☐ BELOW AVERAGE ☐ AVERAGE ☐ ABOVE AVERAGE ☐ OUTSTANDING ☐

COMMENTS FROM CUSTODIAN:

☐ Annual
☐ Special
☐ **Probationary**
☐ 1st mo. ☐ 2nd mo. ☐ 3rd mo.
☐ 4th mo. ☐ Special ☐ Special

WORK APPRAISAL FOR

Name _____

Classification _____

Period from _____ to _____

I. Performance Appraisal (rate each item by selecting the phrase most closely describing the employee's actual work performance).

1. **Job Knowledge**

a. Area work

_____ Needs more training and experience
_____ Able to perform most of the work
_____ Knows enough to get by
_____ Able to perform all work well
_____ Able to perform most of the routine work
_____ No experience in past year

b. Floor work

_____ Able to perform most of the routine work
_____ Needs more training and experience
_____ Able to perform all work well
_____ Able to perform most of the work
_____ Knows enough to get by
_____ No experience in past year

c. Public function setups

Moving
Window washing

_____ Able to perform all work well
_____ Able to perform most of the routine work
_____ Able to perform most of the work
_____ Needs more training and experience
_____ Knows enough to get by
_____ No experience in past year

2. **Ability to Improve**

_____ Has mastered all duties of the position and still has the capacity to do more
_____ Unable to do most of the routine work
_____ Lacks ability to perform the work required by this position
_____ Has mastered most of the duties and still has the capacity to do more
_____ The routine work is the best that can be done and it causes trouble sometimes
_____ _____

3. **Quantity of Work**

_____ Has difficulty in organizing time in order to produce acceptable quantity of work. Has to be told what to do most of the time
_____ Self-starter—makes above average use of work time
_____ Needs prodding or work time will be unproductive
_____ Makes average use of work time and achieves average quantity of work
_____ Self-starter—makes outstanding use of work time
_____ _____
_____ _____

4. **Quality of Work**

_____ Work is outstanding, rarely find items that need improvement
_____ Work is above average, rarely find examples that have been skipped or neglected
_____ Quality of daily and periodic work is average
_____ Weekly checks are necessary
_____ Daily checks are necessary
_____ _____
_____ _____

5. **Attitude Toward Work**

_____ Appreciates help and criticism
_____ Downgrades the school and many of the employees
_____ Does what is expected
_____ Respects the school and his position in organization
_____ Just another job—makes caustic remarks
_____ _____
_____ _____

6. **Initiative**

_____ Little evidence of initiative noticed during working hours
_____ Develops solutions to problems
_____ No indication of initiative during working hours
_____ Develops workable solutions to most problems on his own but keeps supervision informed
_____ Relies on others but follows suggestions
_____ _____

7. **Loyalty**

_____ Critical of the school
_____ Willing to talk about the school in a positive way
_____ Inclined to be one-sided and negative about the school
_____ Self-starter, always willing to explain the school in a positive way
_____ If others insist, he will talk about the school in positive terms
_____ _____
_____ _____

8. **Personality**

_____ Talker but seems to get along with others
_____ Quiet but gets along with others
_____ Gets along with others
_____ Creates some feelings against self
_____ Respected by others
_____ _____

9. **Dependability**

_____ Average in work production and average attendance record
_____ Above average in work production with a perfect attendance record
_____ Average in work production with an unexplained attendance record average of one day sick every two months
_____ Barely average in work production with an above average attendance record

(over)

Work Appraisal *continued*

_____ Above average in work production with an above average attendance record
_____ _____
_____ _____

10. **Accident Prevention**
_____ Talks a lot about safety but doesn't do much about it
_____ Takes chances
_____ Works safely most of the time
_____ Sets a good example in safe work habits and encourages others to do the same
_____ Doesn't take chances but shows little interest in accident prevention
_____ _____
_____ _____

11. **Physical Makeup**
_____ Complains that work is too hard and the job is too large
_____ Accomplishes work with energy to spare
_____ Accomplishes work
_____ Appears tired most of the time
_____ Accomplishes work easily
_____ _____
_____ _____

12. **Cooperation**
_____ He is argumentative
_____ He is an outstanding team worker
_____ He always does what is asked of him
_____ He seldom voices objections
_____ He always does a little more than is asked of him
_____ _____
_____ _____

II. **General Comments**

Comments on outside (second) job _____

Shift preference _____

Health _____

Attendance _____

Progress _____

Suggestions for self-improvement or development _____

_____

Other comments _____

_____

_____ _____

(Date) Signature of person making work appraisal

III. Comments or suggestions by shift supervisor _____

_____

_____

_____

IV. Comments or suggestions by other members of office supervision _____

_____

_____

_____

This work appraisal has been discussed with me

_____ _____

(Signature of employee) (Date)

_____

(Signature of person explaining work appraisal)

DAILY WORK REPORTS

DAILY PERIODIC AREA CLEANING REPORT

Building _____ Loc. No. _____ Date _____

Custodian _____ Hours _____

Area — Use

L—Lab
O—Office
C—Classroom
R—Restroom
H—Hallway

Type of Cleaning

PD—Periodic dusting
CW—Clean-Wax
G—Glass
X—_____
O—_____
XX—_____

Room Number or Area Description	Area Use	Type of Cleaning	Number of Items of Furniture							Other Information
			Chairs	Desks	Tables	Files	Bookcases			

DAY / NIGHT FLOOR MAINTENANCE DAILY WORK REPORT

Building _____ Location _____ Date _____

Name _____ Hrs. _____ Name _____ Hrs. _____

Name _____ Hrs. _____ Name _____ Hrs. _____

Total Hours _____

AREA - USE

L—Lab
O—Office
C—Classroom
R—Restroom
H—Hallway

PROCEDURE

C—Clean
W—2 Coats Wax
55—Safe-T-San
T—Terrazzine
D—Dura Seal
R—Renovate
N—Numastic
S—Strip
F—2 Coats Fin.
SE—Seal

Room No. or Area Descrip.	Area Use	Floor Type	Procedure Used	Sq. Ft.*	Other Info.

*Office Use Only

Continued

DAILY WORK REPORTS *continued*

Day_____
E. Night_____
D. Night_____

CARPET AND UPHOLSTERY WORK REPORT

Building _____ Location _____ Date _____

Name _____ Hrs. _____ Name _____ Hrs. _____

Name _____ Hrs. _____ Name _____ Hrs. _____

Total Hours _____

AREA USE CODE

L—Lab
O—Office
C—Classroom
H—Hallway
ST—Stairs
R—Reception
E—Entrance
_____ Other

PROCEDURE

PL—Pile Lift
SP—Spot Clean
DF—Dry Foam Shampoo
AS—Anti-Static Treatment
OC—Odor Control (Vomit, etc.)

CARPETING

Room No. or Area Description	Area Use	Carpet Type	Carpet Color	Procedures Used	Amount and Type of Cleaning Materials	Square Footage

COMMENTS _____

WINDOW WASHING DAILY WORK REPORT

Building _____ Location _____ Date _____

No. of Men _____ Total Hours _____

Total Hours to Remove Blinds .... _____
Total Hours to Clean Blinds ..... _____
Total Hours to Install Blinds..... _____
Total Hours to Dust Blinds ..... _____
Total Hours to Clean Windows.... _____

☐ Outside and inside
☐ Inside only

Total Hours to Clean Screens..... _____

Area Desc. or Room No.	Venetian Blinds				Glass Washed			Other Info.
	Removed	Washed	Installed	Dusted	Window	Storm Windows	Screens	

MISCELLANEOUS FORMS

CUSTODIAL SUPPLY ORDER

Bldg._____ Loc._____ Date_____

Please fill in *neatly* and leave for person in charge to complete and turn in.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Signature

Location_____

REPAIR NEEDED

Building	Room No.	Date

Work as follows:

_____

_____

_____

_____

_____

Reported by_____

Miscellaneous Forms *continued*

DAILY SWIMMING POOL REPORT

DATE_____ REPORTED BY_____

LOCATION

_____ _____

_____ _____

_____

RECIRCULATION

TIME	STOP	START	TOTAL HOURS	WATER ADDED	PRESS. DIFF.
AM					
PM					

STERILIZATION

TIME	ARRIVE	LEAVE	AVERAGE RATE	CL₂ WEIGHT	CHEMICALS ADDED
AM					
PM					

TIME	STOP	START	TOTAL HOURS	VACUUM MIN. USED	FILTERS WASHED
AM					
PM					

TEMPERATURE				RESIDUAL CHLORINE					
WATER		AIR		pH	Alk	SHALLOW		DEEP	
AM	PM	AM	PM			AM	PM	AM	PM

REMARKS_____

_____

BITUMINOUS PAVING INSPECTION RECORD

Date of Report _____

Location	Total Surface Area	Sq. Ft. Needing Repair	Repair Description and Recommendation	Sq. Ft. Preventive Maintenance	Preventive Maintenance Recommended	Priority			Budget	Remarks
						1	2	3		

BURNER INFORMATION RECORD

MAKE _____ MODEL _____ SERIAL # _____

GAS BURNER

CO_2

High Fire _____

Low Fire _____

CO

High Fire _____

Low Fire _____

Net Stack Temperature

High Fire _____

Low Fire _____

Gas Burning Rate

High Fire _____

Low Fire _____

Gas Pressure at Orifices

High Fire _____

Low Fire _____

Gas Pressure Upstream of all Valves

High Fire _____

Low Fire _____

OIL BURNER, Grade _____

CO_2

High Fire _____

Low Fire _____

Smoke Bachrach Scale

High Fire _____

Low Fire _____

Nozzle Pressure

High Fire _____

Low Fire _____

Oil Burning Rate

High Fire _____

Low Fire _____

Net Stack Temperature

High Fire _____

Low Fire _____

Maintenance Checklist for

ROOFTOP AIR CONDITIONING

Date _____

Unit Model _____

Unit Serial _____

(X) Indicates when checks are made
(/) Indicates service performed

MAINTENANCE CHECKS	Weekly	Monthly	Yearly	Comments and Readings
I. ROOM THERMOSTATS				
A. Check to make sure they respond properly	X			
II. SUPPLY FANS				
A. Listen for bearing noise	X			
B. Grease bearings			X	
C. Check fan belt tension		X		
D. Replace fan belts			X	
E. Check fan sheaves			X	
F. Check for debris in fan inlet		X		
III. RETURN FANS				
A. Listen for bearing noise	X			
B. Grease bearings			X	
C. Check fan belt tension		X		
D. Replace fan belts			X	
E. Check fan sheaves			X	
F. Check for debris in fan inlet		X		
IV. CONDENSER FANS				
A. Listen for bearing noise	X			
B. Grease bearings			X	
C. Check fan belt tension		X		
D. Replace fan belts			X	
E. Check fan sheaves			X	
F. Check for debris in fan inlet		X		

(over)

ROOFTOP AIR CONDITIONING CHECKLIST *continued*

MAINTENANCE CHECKS	Weekly	Monthly	Yearly	Comments and Readings
V. COOLING COIL				
A. Check filters and replace as required	X	X		
B. Clean coil			X	
C. Refrigerant sight glass clear	X			
D. Drain in pan free		X		
VI. CONDENSER COIL				
A. Fan guards in place	X			
B. Clean coil		X		
C. Check and repair fins		X		
VII. REFRIGERANT COMPRESSOR				
A. Check oil level in sight glass	X			
B. Suction line cool to touch	X			
C. Check for short cycling	X			
D. Check for obvious leaks		X		
E. Check control panel wiring and contactors		X		
F. Install refrigerant gauges and check the following:				
1. Suction pressure			X	
2. Discharge pressure			X	
3. Voltage			X	
4. Amperage			X	
VIII. HEATING SECTION				
A. Check flue vents			X	
B. Check burner compartment for flame leakage	X			
C. Listen to burner light off	X			
D. Listen to burner operation	X			
E. Check electrical control panel on electrical heating units		X		
IX. MISCELLANEOUS				
A. Check all damper linkages and lubricate			X	
B. Check all panel door gaskets and caulk panel seams			X	
C. Check insulation on interior panels and repair as necessary			X	

LIGHTING MAINTENANCE LOG: YEAR ( )

Room Number and use	Light Level FT/C	Number and Type of Lighting Fixtures	Lamps Replaced: Quantity, Date, and Location in Room	Ballasts Replaced: Quantity, Date, and Location in Room

MOTOR CONTROLS AND MOTOR MAINTENANCE LOG: YEAR ( )

Motor Item and Use	Horse Power	Voltage and Phase	Name Plate Amps	Operating Amps		Starter				Date Corrected
				Last Year	This Year	Type	Condition	Cleaned and Tightened	Problems Found	

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Annual Inspection Guidelines and Checklists

In addition to the routine maintenance programs described throughout this manual, the authors recommend a special annual inspection of all buildings and equipment. Such an inspection can be invaluable in evaluating the effectiveness of the school maintenance program and in planning and budgeting for the next year's maintenand effort.

The annual inspection suggested here is not designed to replace routine maintenance nor to supersede programs described throughout the manual.

Five separate inspection checklists are provided on the following pages. They cover the major items which must be included during the annual inspection of:

- Buildings—Exterior and Interior
- Plumbing
- Heating and Ventilating Systems
- Electrical Systems
- Fire Protection Equipment

In using these checklists for annual inspections, it is recommended that:

1) **The checklists** should serve as a starting point for developing the school district's own checklists. Lists provided here may not cover all equipment found in a school. Each school may have its own peculiar conditions.

2) **Inspection lists** should be printed and used by the inspector as guidelines in surveying building structures and equipment.

3) **The Annual Inspection** should be made in the early spring, allowing time to plan and perform all repairs during summer vacation.

4) **The inspector should** operate all equipment, such as doors, windows, faucets, flush valves, ventilators, and switches. He should look for leaking valves and faucets, items which have been improperly cleaned, and similar flaws.

5) **The inspector should** make written note of any items missing, broken, or defective. If possible, he should estimate the cost of repair (this may be added later).

6) **Sufficient time** should be allowed to make the inspection a thorough one.

ANNUAL BUILDING INSPECTION CHECKLIST

School _____

Inspector _____

Date _____

EXTERIOR MAINTENANCE	REMARKS	COST EST.
1. Roof		
Cracks		
Blisters (vapor)		
Wrinkles		
Ponding		
Gravel blown off		
Wet insulation		
Dry felts		
Foreign objects on roof		
2. Flashings & Counterflashings		
Composition flashings		
Cracks		
Open joints or end laps		
Pulled away from wall		
Metal counterflashings		
Pulled out of reglets		
Loose wedges		
Deteriorated caulking		
Rusted galvanized iron		
General deterioration		
Expansion joints		
Cracks		
Mislocated or loose blocking		
Deteriorated elastic membrane		

Building Inspection second page	**REMARKS**	**COST EST.**
2. Flashings & Counterflashings—continued		
Gravel stops and gutters		
Peeling paint		
Broken solder joints		
Separated from roof plies		
3. Skylights		
Secured to supports		
Cracks, etc.		
4. Plumbing Vents		
Vandalism		
5. Antennas, Signs, Etc.		
Rust and peeling paint		
Loose guys		
Roof seal		
6. Parapets		
Open mortar joints		
Open joints in copings		
7. Chimneys		
Deteriorated brick, joints		
Flue liner		
Flashing		
8. Walls		
Cracks		
Paint condition		
Moisture (efflourescence, etc.)		
Areaways		
Caulking		
Windows (paint, etc.)		

Building Inspection third page	REMARKS	COST EST.
8. Walls—continued		
Doors		
Closers		
Exit devices		
Locks and misc. hardware		

INTERIOR MAINTENANCE

1. Structural System		
Rot, splitting, rust		
Termites		
Deflection		
Cracks		

2. Stairs and Handrails		
Loose handrails (anchorage)		
Worn treads		
Paint or varnish, etc.		

3. Interior Walls		
Cracks, bulges, etc.		
Paint conditions		
Dirt		

Building Inspection fourth page	**REMARKS**	**COST EST.**
4. Ceilings		
Cracks, bulges, etc.		
Paint condition		
Dirt		
5. Floors		
Wood		
Deteriorated areas		
Finish condition		
Resilient floor coverings		
Damaged areas		
Finish condition		
Carpet		
Stains		
Dirt		
Base		
Stains		
Dirt		
Paint condition		
6. Doors		
Closers		
Exit devices		
Hinges		
Locks and Latchsets		
Keying		
Misc. door hardware		

Building Inspection fifth page	REMARKS	COST EST.
7. Windows		
Putty and caulking		
Broken and cracked glass		
Sash operation		
Hardware		
Decay and termites		
Sills and stools, paint, etc.		
8. Shades and Blinds		
Hardware		
Blades (dirty or paint cond.)		
Fabric		
Rollers		
BUILT-IN EQUIPMENT		
1. Lockers		
Hardware		
Numbering		
Paint condition		
Doors (warped or damaged)		
2. Stage Equipment		
Curtains and backdrops		
Track, hardware, etc.		
Rigging, counter weights, etc.		
Dimmer equipment (by electrician)		
Lubricate as required		
Lighting (bulb, etc.)		
3. Auditorium Seating		
Anchorage		
Dirt		
Damage to fabric, missing parts		

Building Inspection sixth page	**REMARKS**	**COST EST.**
4. Auditorium and Gym Exits		
Exit lights		
Exit devices		
Emergency lighting		
5. Gymnasium Equipment		
Bleachers		
Damaged boards		
Lubricate as required		
Hardware		
Backstops and bankboards		
Paint condition		
Loose bolts and hardware		
Motorized equipment--check and lube		
Check cables, pulleys, etc.		

ANNUAL PLUMBING INSPECTION CHECKLIST

School _____

Inspector _____

Date _____

EXTERIOR	REMARKS	COST EST.
1. Storm Drainage		
Catch basin		
Broken or missing grate		
Filled with rubbish		
Drain pipe		
Clogged		
Broken		
Areaways		
Filled with rubbish		
Broken drain		
Ground hydrants		
Sill cocks		
Downspouts		
Water valve boxes		
Gas piping		
Grease interceptor		
2.		

INTERIOR		
1. Corridor		
Cleanouts		
Drinking fountains		
Electrical water coolers		

Plumbing Inspection second page	REMARKS	COST EST.
2. Toilet Room		
Water closet		
Water closet seats		
Water closet valves		
Water closet tanks		
Lavatory		
Faucet		
Drain		
Urinal		
Valve		
Tank		
Drain		
Soap		
Dispensers		
Tank		
Floor drain		
3. Kitchen		
Sink		
Faucet		
Drain		
Disposer		
Gas valves (check pilots if shut off)		
Range		
Dishwasher		

Plumbing Inspection third page	REMARKS	COST EST.
3. Kitchen—continued		
Booster heater		
Gas pilot		
Temperature (190°F.)		
Flue venting		
Faucets		
Floor Drains		
4. Home Economics		
Gas valves & pilots		
Sink		
Faucet		
Drain		
Disposer		
Washer		
Faucet		
Drain		
5. Science		
Gas		
Air		
Sinks		
Faucets		
Drains		

Plumbing Inspection fourth page	**REMARKS**	**COST EST.**
6. Shop		
Gas		
Air		
Gasoline and oil interceptor		
Drains		
7. Elevator		
Drain		
Sump pump		
8. Equipment Rooms		
Drain from cooling units		
Valves		
Drains		
Sump pumps		
Sewage ejectors		
Water heaters		
Circulating pumps		
Thermometers		
Water meter		
Gas piping		
9. Roof		
Drains and downspouts		

ANNUAL HEATING AND VENTILATING SYSTEMS INSPECTION CHECKLIST

School _____

Inspector _____

Date _____

EXTERIOR

The inspection of the exterior heating system consists of carefully noting the location and condition of the scheduled items.

Items to look for are:

1) Vandalism.
2) Badly rusted equipment and supporting devices requiring complete cleaning, priming and painting.
3) Masonry (chimneys) that is missing or masonry requiring tuck pointing of joints. Also masonry that is badly deteriorated by weathering or other action.
4) Damaged oil filling stations — including pipe and fittings.
5) Damaged vent piping and fittings.
6) Equipment and/or supporting devices so badly rusted or broken requiring replacement of parts.
7) Oil tank corrosion.
8) Bent and otherwise damaged louvers, bird screens, exterior dampers, ventilation equipment intake or exhaust ducts.
9) Inoperable exterior dampers.
10) Roof or wall type fan operation:
    (a) Fan running;
    (b) Damper operating.
11) Relief dampers or relief vents condition.
12) Roof flashing condition at:
    (a) Roof fan units;
    (b) Duct openings;
    (c) Pipe openings.
13) Chimney condition including supports.
14) Chimney weather cap conditions.

EXTERIOR	REMARKS	COST EST.
1. Chimney & Gas Vents		
Masonry		
Metal		
Cap		
Roof flashing		
2. Roof Fan		
Fan operable		
Damper		
Roof flashing		
Bird or insect screen		
General condition		

Heating and Ventilating Inspection second page	REMARKS	COST EST.
3. Roof Relief Openings		
Roof flashing		
Damper		
General condition		
4. Duct Intake or Exhaust		
General condition		
Roof flashing		
Bird or insect screen		
External damper		
Louvers		
5. Oil Tank		
General condition		
Sludge		
Fill piping		
Vent piping		
6. Gas		
Pipe condition		
Valves		
Vent pipe		
7. Wall Fan		
General condition		
Fan running		
Damper		
Flashing		
Bird or insect screen		
8. Unit Ventilator		
Exterior louver		

Heating and Ventilating Inspection third page

INTERIOR

The inspection of the interior heating system consists of carefully noting the location and condition of the scheduled items. Special note should be taken of noisy operation, leaks, excessive dirt accumulation, non-uniform temperatures, bearing failure.

Items to look for are:

1) Vandalism.
2) Inoperative equipment.
3) Damaged equipment.
4) Missing equipment.
5) Excessive noise.
6) Excessive vibration.
7) Excessive dirt, rust or scale.

Where equipment has movable parts, they should be operated. Burners and stokers should be operated and all operating and safety controls checked for proper working condition. Pumps, fans, heating units, heating and ventilating units, etc., should all be operated by means of their normal control devices.

Controls should be checked by competent mechanics on a twice-a-year basis. Maintenance contracts with a control manufacturer are desirable. Electrical and gas apparatus should be continually checked for deterioration, leaks, etc.

Indicate the condition of the various items, location, or other identification, type of service, repair or replacement needed, estimated cost if possible.

INTERIOR	REMARKS	COST EST.
1. Boiler		
General condition		
Smoke vent and/or breeching		
Draft control damper		
Insulation		
Relief valves		
Boiler tubes		
Burner or stoker		
Controls		
Boiler feeder		
Water glass		
Combustion air intake		
Blow-down		
Water treatment		
2. Pumps		
Boiler feed pump		
General condition		
Motor		
Valves		
Tank		
Insulation		
Controls		
Pressure valve		

Heating and Ventilating Inspection fourth page	REMARKS	COST EST.
Condensate pump		
General condition		
Motor		
Valves		
Receiver		
Controls		
Circulating water pump		
General condition		
Motor		
Valves		
Controls		
3. Expansion Tank		
General condition		
Site glass		
Water level		
4. Valves		
Leaking		
Packing		
Ease of operation		
5. Traps		
Float		
Seat		
Orifices		
6. Convectors and/or Baseboard Radiation		
General condition		
Coils, dirty		
Valves		
Trap		

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Heating and Ventilating Inspection fifth page	REMARKS	COST EST.
7. Forced Flow Convectors or Fan-Coil Units		
General condition		
Coils		
Controls		
Valves		
Motor		
Belt		
Bearings		
Trap		
Fan		
8. Unit Ventilator (Steam, Water or Gas)		
General condition		
Coils, dirty		
Filter, dirty		
Motor		
Belt		
Bearings		
Fan		
Trap		
Dampers		
Controls		
Valves		
Outside air intake		
Combustion air intake		
Burner		
Gas valves & regulator		
Pilot and heat exchanger		
Vent and flashing		
9. Unit Heater (Steam, Water or Gas)		
General condition		
Coil, dirty		

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Heating and Ventilating Inspection Sixth page	REMARKS	COST EST.
9. Unit Heater—continued		
Motor		
Fan		
Bearings		
Valves		
Trap		
Burner		
Controls		
Belts		
Draft inducer		
Gas valve & regulator		
Pilot		
Burner and heat exchanger		
Gas vent and flashing		
10. Furnace		
General condition		
Filter, dirty		
Motor		
Belt		
Bearing		
Dampers		
Burner		
Controls		
Fan		
Gas valve & regulators		
Gas vent and flashing		
Outside air intake		
Combustion air intake		
11. Ventilating Units		
General condition		
Filter, dirty		
Motor		

Heating and Ventilating Inspection seventh page	REMARKS	COST EST.
11. Ventilating Units—continued		
Sheaves		
Belt, tension and condition		
Fan		
Bearings		
Trap		
Valves		
Dampers		
Controls		
Burner		
Coils dirty		
Outside air intake		
Roof flashing		
Gas valve & regulators		
Pilot		
Burner and heat exchanger		
Gas vent and flashing		
Combustion air intake		
12. Control System		
General condition		
Compressor		
Air filter — dryer		
Thermostats		
Valves & valve operators		
Summer-winter change-over switch		
Tubing or wiring condition		

ANNUAL ELECTRICAL SYSTEMS INSPECTION CHECKLIST

School _____

Inspector _____

Date _____

ELECTRICAL SYSTEMS	REMARKS	COST EST.
1. Main Service		
Inadequate capacity		
Insufficient grounding		
Obsolete wiring insulation		
Obsolete entrance equipment		
2. Distribution System		
Overloaded branch circuits		
Obsolete wiring insulation		
Insufficient receptacles		
Oversize fuses		
Excessive extension cords		
3. Lighting		
Insufficient light intensity		
Broken fixtures		
Lamp replacement		
Need for outdoor lighting		
Emergency lighting needed		
4. Special Outlets Needed for:		
Shop equipment		
Kitchen equipment		
Laboratory equipment		
Home Ec. equipment		
Arts and crafts		

Electrical Systems Inspection second page	REMARKS	COST EST.
5. Fire Alarm System		
Does not conform to School Code		
Needs maintenance		
Faulty break-glass stations		
6. Exit Signs		
Inadequate number of signs		
Need maintenance		
Lamp replacement		
7. Clock and Program System		
Inadequate number of clocks		
Inadequate program bells		
Needs maintenance		
8. Other Systems Needing Attention		
Intercommunication		
Public address		
Television		
Scoreboard		

ANNUAL FIRE PROTECTION EQUIPMENT INSPECTION CHECKLIST

School _____

Inspector _____

Date _____

FIRE PROTECTION EQUIPMENT	REMARKS	COST EST.
1. Sprinkler Systems		
Valves		
Must be O.S. & Y. type		
Must be open		
Corrosion repairs		
Flow alarms		
Required for system with 5 or more sprinkler heads. UL approved		
Must activate building fire alarm system		
Dry pipe systems		
Check for proper air pressure in system		
Check low air pressure alarm system. Should actuate fire alarm system trouble signal		
Pressure or storage tanks		
Check for proper pressure		
Check for proper water level		
Check low pressure or low water alarm system. Should actuate fire alarm system trouble signal		
Distribution piping & sprinkler heads		
Check for leaks & corrosion		
Check for adequate hangers		
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Fire Protection Equipment Inspection second page	**REMARKS**	**COST EST.**
2. Standpipe & Hose Equipment		
Hose & hose rack or cabinet		
Is hose properly stored & readily accessible?		
Is hose attached to standpipe with nozzle open & ready for use?		
Is hose serviceable without leaks, decay, etc.?		
3. Fire Extinguishers		
Check hose, nozzle, gaskets & examine for deterioration.		
Check for injuries due to misuse		
Test pump action type to see if pump functions		
Test continuous-stream type by pumping up pressure and ejecting vaporizing liquid in both up-and-down and around-the-clock positions		
Test stored-pressure and CO_2 by discharging small amount of liquid or foam to atmosphere		

GENERAL COMMENTS:

Soda-acid and chemical-foam type extinguishers should be examined several times each year to see that they have not been tampered with, are not empty, have not been removed from their designated places.

Cartridge-operated type extinguishers should be inspected to see that the water level is up to the proper mark. Cartridges should be removed, examined and weighed. If there is a weight loss of ½ ounce or more for cartridges, they should be discarded. Other inspection procedures should be the same as for soda-acid extinguishers.